STUDY
OF
THE ENERGY NEEDS
OF SLUM AREAS OF DELHI

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Project team

Dr. P.K. Monga	Fellow
Mr. Atul Kansal	Research Associate
Ms. Priyamvada Zutshi	Research Associate
Ms. Kiran Bhatty	Research Associate
Mr. D.P. Singh	Director, DEDA
Mr. Ashutosh Kumar	Deputy Director, DEDA
Mr. S.P. Singhal	Consultant

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Contents

1. Urbanisation and growth of slums 1

1.1 Urban growth in India 2

1.2 Rururban migration 3

1.3 Urban development in Delhi 5

1.4 Urban slums 8

2. Urbanisation and energy use 12

3. Scope and methodology 24

3.1 Objectives 24

3.2 Approach 25

3.3 Methodology 27

3.4 Survey methodology 32

3.5 Drawbacks and limitations of data 33

3.6 Second survey 34

4. Data analysis 35

4.1 Socio-economic profile of slum areas 35

4.2 Energy use 37

4.3 End-use wise energy consumption pattern 42

4.4 Future trends 46

5. Fuel substitution and integration with overall urban development plan 58

References 109

List of tables

1.1 Population of large cities in India and trends in annual growth rates . . . 3

1.2 Volume of migrants to large cities from rural/urban areas of India, 1991 . . . 4

1.3 Population of some important areas . . . 6

1.4 Population projections for Delhi . . . 7

1.5 Housing targets of various agencies . . . 9

1.6 Population of various sub-standard areas of Delhi . . . 10

2.1 Energy use and its related parameters: comparison between countries . . 14

2.2 Correlation between GNP per capita and different parameters . . . 15

2.3 Urban-rural differences in energy consumption: 1977-78 . . . 16

2.4 Percentage share of different forms of energy in urban and rural households . . . 17

2.5 Household energy patterns and city size: 1978-79 . . . 17

2.6 Fuel shares for cooking and water heating by income . . . 18

2.7 Household energy consumption in selected cities . . . 19

2.8 Per capita consumption of different fuels by income classes (All India urban) . . . 20

2.9 Percentage share of energy consumption for different end-uses by income categories (All India Urban) . . . 21

2.10 Percentage share of fuel mix pattern for different end-uses (All India urban) . . . 21

2.11 Percentage share of energy consumption across different end-uses (All India urban) . . . 22

2.12 (a) Energy demand projections in urban household . . . 22

2.12 (b) Energy demand projections in urban households (contd.) . . . 22

2.13 Annual domestic energy demand including rural and urban households . 23

3.1 Zonewise and typewise distribution of selected clusters . . . 29

3.2 Zonewise and typewise distribution of selected households . . . 30

3.3 Typewise distribution of clusters and households . . . 31

3.4 Zonewise distribution of clusters and households . . . 31

4.1 Income distribution 36

4.2 Monthly fuel consumption in the domestic sector 38

4.3 Average monthly household energy consumption (south zone) 40

4.4 Average monthly household energy consumption (north zone) 40

4.5 Average monthly household energy consumption (east zone) 40

4.6 Average monthly household energy consumption (west zone) 41

4.7 Average monthly household energy consumption (central zone) 41

4.8 Average monthly household kerosene consumption for cooking and lighting 43

4.9 Average monthly household electricity consumption for lighting, heating, cooling and entertainment 44

4.10 Average monthly household electricity use across income categories (east zone) 45

4.11 Average monthly household electricity use across income categories (central zone) 45

4.12 Average monthly household electricity use across income categories (south zone) 46

5.1 Expenditure statement on urban development for the VII Five Year Plan 59

5.2 Budget allocation in the VIII Five Year Plan 60

5.3 Salient features of DEDA annual plan 61

List of figures

4.1 Average monthly fuel consumption (zone-wise) 47
4.2 Monthly energy consumption (South zone) 48
4.3 Monthly energy consumption (North zone) 49
4.4 Monthly energy consumption (East zone) 50
4.5 Monthly energy consumption (West zone) 51
4.6 Monthly energy consumption (Central zone) 52
4.7 Income distribution (zone-wise) 53
4.8 Monthly electricity consumption across income classes 54
4.9 (a) Fuelmix across various zones 55
(b) Fuelmix across various zones (Contd..) 56
4.10 Monthly energy consumption (zone-wise) 57

List of annexures

Urban slums and policy planning 63
List of selected clusters 79
Primary survey questionnaire 86
Second survey questionnaire 88
Frequency distribution of fuels 89

List of abbreviations

C	Central zone
cc	Calorific value of coal
cd	Calorific value of dungcake
ce	Calorific value of electricity
cf	Calorific value of fuelwood
ck	Calorific value of kerosene
CMIE	Centre for Monitoring Indian Economy
DDA	Delhi Development Authority
DEDA	Delhi Energy Developemnt Agency
DESU	Delhi Electric Supply Undertaking
E	East zone
FRG	Federal Republic of Germany
GNP	Gross National Product
GOI	Government of India
JJ	*Jhuggi Jhopri*
kCal	Kilo Calories
kg	Kilo gram
kgoe	Kilogram oil equivalent
kJ	Kilo Joule
kl	Kilo litre
kWh	Kilo Watt hour
LPG	Liquefied Petroleum Gas
MJ	Mega Joule
N	North zone
NCAER	National Council of Applied and Economic Research
PPS	Probability Proportional to Size
PSU	Primary Sampling Unit
S	South zone
SSU	Secondary Sampling Unit
te	Total energy
TERI	Tata Energy Research Institute
UK	United Kingdom
USA	United States of America
VCR	Video Cassette Recorder
W	West zone

Chapter 1

Urbanisation and growth of slums

The growth of urban population has been quite staggering in India. Less than 60 million at the time of independence about four decades ago, the urban population has more than tripled since then, and expected to reach 300 million mark by the turn of the twentieth century. With approximately 27 percent of the population living in the urban areas, India is one of the least urban countries. However, with an urban population of 217 million (1991), it is also a country with the largest urban population. Nearly two thirds of the urban population in India is concentrated in 317 Class-I cities (population over one lakh) of which half lives in 23 metropolitan areas with population exceeding 1 million. The Class-I cities are the fastest growing urban areas in India. The four largest cities- Bombay, Calcutta, Delhi and Madras - between them account for one-sixth of the urban population in India. The National Commission on Urbanization (1988), states that "these urban centres have also generated the most brutal and inhuman living conditions, with large sections of the citizens living in squatter settlements. The overcrowding in the slums, and the desperate lack of water and sanitation leads not only to severe health problems but to abject degradation of human life."

The estimate of proportion of urban people living in slums in India varies from about 20 to 30 percent. Looked at by class of town, the highest percentage of people living in slum areas is in the cities with a million plus population and the least in towns with less than 1 lakh population. The growth rate of slum population, largely through migration, is significantly faster than that of other segments of the urban population. While this phenomenon is in no way unique to India, it is the sheer size of the problem in india that is staggering.

About 27 percent of the urban population lives below the poverty line while 30-40 percent of the total population of the larger metropolitan areas lives in slums. Around 27 percent does not have access to safe water and over 75 percent does not have access to water-borne sanitation. Indian cities also have very high levels of air and water pollution. But yet people migrate. According to one estimate, over 13500 people each day move from rural to urban environments. The pertinent question is not so much why the urban poor decide to stay in slums, or do they have any choice, but rather how much remains to be done about improving conditions in these areas. The report of the National Commission on Urbanisation reveals that "for whatever reasons, resource allocation in the urban field seems to follow a problem rather than anticipate it."

Looking deeper into this problem, it was felt that one of the important critical inputs to development which has been overlooked in almost all the urban planning exercises is energy. Secondly, though some of the estimates talk of urban energy demand, nowhere a mention is made of the energy demand of slum areas. As slum population now accounts for approximately 40 percent of the total population of metropolitan cities, this strata of the society, which is very poor and does not have access to resources, is also responsible for a large share of the energy demand in these cities. In this study, therefore, an attempt has been made to assess the present and future energy demand scenarios for the slum areas of Delhi.

1.1. Urban growth in India

There are twelve cities which had a population of million or more in the 1991 census in India i.e. Calcutta, Greater Bombay, Madras, Delhi, Bangalore, Ahmedabad, Hyderabad, Pune, Nagpur, Lucknow, Jaipur and Kanpur. Their total population in 1991 was estimated to be 42.1 million or 6.1% of the nation's population while in 1961, these 12 cities had a total population of 21.6 million or 4.9% of the total population of the country. Thus the population of the large cities has nearly doubled in 20 years with an average annual growth rate (exponential) of 3.35% per year. During the same period, the growth rate for the country, as a whole, was 2.22% per year. Thus the population of these large cities has been increasing by an additional growth rate of 1.13% per year (assuming that the natural increase of the population of the cities is almost the same as for the country as a whole, which is empirically valid) which is due to net in-migration of population into these cities from rural areas. Data on the population of these twelve large cities in 1961, 1971, 1981 and 1991 reveals emerging trends in their demographic growth rates.

Table 1.1. Population of large cities in India and trends in annual growth rates

Large city	Population in '000s				Average annual growth rate (Exponential) in %		
	1961	1971	1981	1991	1961-71	1971-81	1981-91
1. Ahmedabad	1206	1752	2548	3297	3.73	3.78	2.61
2. Bangalore	1207	1664	2922	4087	3.21	5.68	3.41
3. Greater Bombay	4152	5971	8243	12572	3.63	3.25	4.31
4. Calcutta	5984	7420	9194	10916	2.15	2.16	1.73
5. Delhi	2359	3647	5729	8375	4.36	4.55	3.87
6. Hyderabad	1249	1796	2546	4280	3.63	3.52	5.33
7. Jaipur	410	637	1015	1514	4.41	4.70	4.08
8. Kanpur	971	1275	1639	2111	2.72	2.53	2.56
9. Lucknow	656	814	1008	1642	2.16	2.16	5.01
10. Madras	1944	3170	4289	5361	4.89	3.05	2.25
11. Nagpur	690	930	1302	1661	2.98	3.35	2.46
12. Pune	791	1135	1686	2485	3.61	3.99	3.95
TOTAL	21619	30211	42121	58301	3.25	3.35	3.46

1.2. Rururban migration

Migration of rural people to urban areas (Rururban) takes place for various economic and social reasons. The recent census data (1991) reveals that the primary cause of migration of males to the cities is to seek employment and of females due to marriage accompanying their husbands employed in cities. Thus, employment opportunities and marriage seem to be the underlying forces of migration of men and women into the cities in India. The migrants come to the large cities not only from rural areas but also from other urban centres of the country. Table 1.2 provides data on the volume of migration from rural areas and urban areas to the 12 metropolitan cities separately for males and females, as assessed from the place of birth data in the 1981 census. In Greater-Bombay, about 4.1 million persons or almost 50% of the city population have declared their place of birth as outside Bombay. About 68% of the migrants are from rural areas and 32% from other urban areas.

On the other hand, in Calcutta, only about 2 million (22% of the city's population) have reported their place of birth as outside Calcutta. Among these migrants, 1.35 million (or 68%) were from rural areas and 0.64% million (32%) were from urban areas. In the large cities as a whole, the rural migrants had a higher (50%) proportion of males than the urban migrants (52%). In the metropolitan cities of Madras, Lucknow, Jaipur, Delhi and Bangalore, the number of migrants from other urban centre is higher than from rural areas (as determined from the place of birth). These data indicate that it is not always the rural population with all the so-called rural characteristics that migrate to the metropolitan cities, but that substantial proportions of the migrants to large cities are drawn from other smaller urban centres in the country (Srinivasan, K. 1990).

Table 1.2. Volume of migrants to large cities from rural/urban areas of India, 1991.

Large City	Number of migrants to large cities					
	From rural			From urban		
	Male	Female	Total	Male	Female	Total
1. Ahmedabad	315577	266395	581972	174185	185347	359532
2. Bangalore	248693	237459	486152	293311	276189	569500
3. Greater Bombay	1764446	1036876	2801322	715032	612154	1327186
4. Calcutta	845516	505146	1350662	356647	279627	636274
5. Delhi	677934	452742	1130676	693070	623130	13162000
6. Hyderabad	132548	124775	257323	124806	120517	245323
7. Jaipur	79035	67778	146813	79833	83667	163500
8. Kanpur	153421	120332	273743	92596	92898	185494
9. Lucknow	69110	53874	122984	70747	71311	142058
10. Madras	292852	268928	561780	433444	432573	876017
11. Nagpur	133058	130381	263439	85901	95980	181881
12. Pune	226467	201450	427917	187241	182546	369787
TOTAL	4938657	3466126	8404783	3316813	3055939	6372752

1.2.1. Occupational distribution of migrants

It is normally believed that most of the migrants come to the city mainly in search of menial jobs. Table 1.3 throws light on the occupational distribution of the life-time migrants in the 12 metropolitan cities of India. It is true that a high proportion of the workers from among the migrants are engaged in the category of 'production and related workers, transport equipment operators and labourers'. The highest proportion in this category is seen in Ahmedabad with 57.6% of the life-time migrants employed in this category and the lowest is observed in Lucknow with 27.5% in this category. However, data also reveals that the percentage of migrants employed in professional, technical and related activities is also quite high ranging from 17.8% in Hyderabad and 15.7% in Nagpur to 4.7% in Calcutta. Thus a substantially high proportion of the life-time migrants in the metropolitan cities are engaged in professional, executive, managerial, sales and service sectors and contribute significantly to the economic development of the cities.

The economic structure of the metropolitan cities in India is such that all the sectors of the economy are very closely inter-connected. In all sectors such as industries, construction of housing complexes, laying of roads, water and sewerage pipes, railway lines, etc., there is an enormous and continuous demand for skilled and unskilled workers. This demand is met largely by the migrant labourers from rural and smaller urban areas. Migrants come to the metropolitan cities for almost permanent stay. The tertiary sector which is unorganised provides the services, such as hawkers, vendors, house-maids, cart-pullers, etc.. These services are essential for the survival of the economy in the metropolitan cities. Thus there is a need to look into various aspects of urban slums in order to come up with strategies and plans for improvement of their living conditions.

1.3. Urban development in Delhi

1. Migration

The genesis of Delhi's growth lies in the increasing urbanisation which continues to offer the most important opportunities for employment and to provide the basis for specialisation and increased productivity in manufacturing and supporting services. Delhi is growing at a rapid pace because of continuous influx of migrant population. Being a capital city, Delhi always has serious problems of land, housing, transportation, and provision and management of essential infrastructure. Major migration to Delhi is from the states of Uttar Pradesh, Haryana, Punjab and Rajasthan. The present range of influx migration is around 1.6 lakh person per annum. While it may not be possible to make a precise forecast, the expectation is that, the population of Delhi would range between 12.5 and 13 million in the year 2001. It is therefore important that requirement of land, infrastructure, transportation, and basic inputs, etc. be planned accordingly.

2. *Population*

Like other urban centres in the developing countries, the city of Delhi has, in the last 2-3 decades grown at a phenomenal rate. The 1991 census puts the total population of Delhi at 9.37 million. Of this, the natural growth of population accounts for 35,000 families per year, and migration for 40,000 families per year. As a result, the density of population now stands at 6319 persons per square kilometre.

It is expected to cross the ten million mark by the end of the Eighth Five Year Plan. The spatial distribution of population in some of the densely populated areas of Delhi is as under :

Table 1.3. Population of some important areas

Area	Population (In lakhs)
Karol Bagh	4.20
Civil Lines	7.50
New Delhi	7.50
South Delhi	12.70
West Delhi	14.30
North-West Delhi	17.65
Mehrauli-Badarpur	2.50
Papankalan	5.50
Narela	3.00
Rohini	3.50
Total	78.35

In 1971-81, the urban population of Delhi showed an annual growth rate of 4.55 per cent, while during 1981-91, the increase has been 5.64 percent. The later is being influenced by the gradual shifting of the rural areas and its merger with urban areas of Delhi. If the same rate of population growth continues, the urban population of Delhi by the end of the year 2001 would be 144.26 lakh while rural population would account for 5.27 lakh. Envisaging a more balanced regional development, the population for the union territory of Delhi has been projected as under:

Table 1.4. Population projections for Delhi

Population within the Delhi Urbanisable Limits-2001	121.73 lakh
Population outside the Urbanisable Limits-2001	6.37 lakh
TOTAL	128.10 lakh

3. Employment

There has been considerable change in the industrial structure of the city in the past three decades and more so after 1975. The following two types of industries which are present need based, have grown very rapidly- Electrical & Electronics and Rubber, Plastic & Petroleum products in Delhi. There were about 46,000 industrial units in 1981 with 77 per cent with less than 10 workers and 16 per cent with workers between 10 to 20. By 2001, the number of industrial units in Delhi are likely to increase to about 93,000. The percentage of work force in the industrial sector has been constantly increasing. With the generation of employment opportunities in different sectors of economy, the participation rate for 2001 should be of the order of 35 per cent in Urban Delhi, and 33 per cent in the area outside the urbanisable limits of Delhi. This would generate a total work force of 49.08 lakh including the floating worker population who keep coming to Delhi for work, though not to reside in the city. Moreover, here is a conscious move on the part of the administration to discourage new units or shut down old industrial units responsible for industrial pollution in Delhi.

4. Housing need

Housing has strong spatial relationship with employment opportunities, social services and other urban activities. Besides shelter, housing also acts as a vehicle for social change for aspects such as welfare of women and children, removal of adult illiteracy and expansion of public distribution system. Housing policy is also known as a major tool for influencing the efficiency and equity in urban areas and same is true in the case of the capital Delhi also.

As urban population in the country is growing at a rapid pace, all metropolitan cities as well as big and small towns are facing housing crunch. Delhi is no exception. Provision of shelter in the form of affordable dwelling units is the main concern of State Housing bodies. In Delhi, this responsibility is entrusted to the Delhi Development Authority (DDA). The task faced by DDA is not an easy one, especially in view of the haphazard growth taking place in and around Delhi.

Urban Delhi in 1981 accommodated about 11.5 lakh households in different housing development - resettlements, squatter, plotted, multi-family, unauthorised, villages, traditional and others. About 16.2 lakh new housing units would be required by 2001. However, according to the planned estimates, only another 13 lakh households would be added during this period. Based on the field studies, an indicative percentage of such a provision by different agencies is given in Table 1.5.

Thus, it is expected that housing shortage would be of the order of about 3.0 lakh which includes (i) squatters and shelterless, (ii) families sharing houses in the congested built-up areas, and (iii) houses requiring immediate replacement.

1.4. Urban slums

Slums and *Jhopar basties* have become synonymous with urbanisation and all major metropolitan cities in India have large sections of population residing in inhumane and sub-standard conditions. Delhi has a large population of urban poor residing in slum areas. In spite of efforts made to improve, upgrade, relocate and re-develop sub-standard areas, by various public agencies such as DDA and its Slum Wing, no headway seems to have been made in improving the quality of life for the urban poor in these areas. It is estimated that around 40-50 per cent of the total population in the city lives in sub-standard areas namely jhuggie clusters, designated slum areas, resettlement colonies, unauthorised-regularised colonies and urban-rural villages. Three main underlying factors are (i) inadequate supply of housing units for the urban poor through public agencies and private efforts, (ii) unchecked migration of population and (iii) absence of any integrated planning for urban poor.

Table 1.5. Housing targets of various agencies

Housing Type	Land Development Agency	Construction Agency	%age of housing
Slum housing	Slum Department	Slum Department	3
Houses on individual plots	Major part already developed	Individual family	17
Employer housing	Central Government, Delhi Admin. and local bodies	Central Government, Delhi Administration and local bodies	4
Regularised infil	Individual	Individual	8
General Housing			
(a) Site and services	Housing Agency	Individual family	25
(b) Built and partially built houses	Housing Agency and Cooperatives	Housing Agency and Cooperatives	43

According to the Slum Improvement and Clearance Act, 1956, a slum area is defined as any structure, group of structures or area, which is unfit for human habitation due to deficiencies in the nature of accommodation and/or in the environment. Such an area by notification in the Official Gazette is declared a slum. In Delhi, surprisingly the only notified slum area is the walled city of Shahjahanabad, consisting of a population of 1.8 million (1991 census). Although water supply lines and sewer lines are available in all parts of the walled city, but still about 25 per cent of the houses are without municipal water supply and about 50 per cent of the houses are without municipal sewerage connection. However there are many other areas in the city, with sub-standard living conditions, which though not notified would qualify as slum or as having slum-like conditions. These are (a) JJ clusters and their settlement which are the "squatter settlements" or *"jhuggi-jhopri"*, (b) unauthorised colonies/clusters that consist largely of tenements made of mud, bricks, straw, bamboo, wood and other such materials, and encompass a population of 1.3 million (1991 census) and (c) resettlement colonies. At present about 47 lakhs people live in sub-standard areas in Delhi with the following break-down.

Table 1.6. Population of various sub-standard areas of Delhi

Area	Population
Jhuggi clusters	12 lakhs
Slum designated areas	18 lakhs
Resettlement colonies	12 lakhs
Unauthorised colonies	5 lakhs
Total	47 lakhs

a) JJ clusters

These *jhuggi-jhopri* or JJ clusters have been growing since independence, with the recent decades seeing an unprecedented increase in their numbers. The genesis of this growth is two-fold. On the one hand, the increasing pressure on land forces people to move from rural areas, and on the other, increase in manufacturing and supporting services in the urban centres, offering the most lucrative opportunities for employment, lures millions of aspirants into the Delhi Metropolis. Between 1971-1981, the pattern of migration into Delhi from different states has been as follows:

States	% of total migration
Punjab	6.4
Rajasthan	7.5
Uttar Pradesh	50.1
Haryana	12.9
Madhya Pradesh	3.1
Other states	20.0

Unable to find housing facilities commensurate with their income levels, many of these migrants are forced to settle down (squat) on unused plots of land, preferably close to their place of work. The Delhi administration's inability to provide housing and other facilities to them and political patronage has resulted in these settlements turning into slums. An almost complete lack of civil amenities and extreme congestion have led to these areas being characterised by poverty, filth and unhygienic conditions. Between 1951 and 1973, the overall annual rate of growth of squatter households was found to be 11.8 per cent as compared to the 4.5 per cent for Delhi as a whole. (Mazumdar, T.K., 1986)

(b) Unauthorised colonies

There are about 600 unauthorised colonies, with a population of five lakhs, existing in the city. This colonies have come up due to lack of discipline, monitoring and follow up action. Regularisation may not always be helpful in improving the low level of physical environment existing in these colonies. For improvement of physical and social infrastructure, the house owners in these unauthorised colonies need to organise themselves into societies for improvement of civic amenities.

(c) Resettlement colonies

Immediate need of the resettlement colonies, with a population of twelve lakhs, is individual services i.e., water, sewerage and electricity.

Chapter 2

Urbanisation and energy use

Increasing urbanisation and the growing energy demand are closely linked. Urban households purchase a large share of their goods and services from outside, whereas rural population fulfils most of its needs from their own environs. The commercial providers of these goods and services in urban areas are more likely to use fuel and other energy forms in higher quantities than the rural household. Higher density of population in urban areas also induces substitution of convenient and modern fuels for traditional energy forms. Usually these substitutions allow a smaller total quantity of input energy to supply the same or larger energy outputs, dampening the tendency for urbanisation to increase energy intensity of production. However, rising per capita incomes associated with urbanisation, increases demand for end-use energy as well as energy intensive products and services.

Further, the relative position of the urban poor or people residing in slum areas, in terms of energy use is worsening in many cases. As they do not have access to resources and technologies, they have to spend a higher proportion of their income on energy and are forced to use traditional forms of fuels even while staying within urban limits. Impact of urbanisation on the energy scene of our country could be summarised as under:

- ★ A district shift from traditional energy sources to modern fuels;
- ★ A definite increase in energy use on account of demand for new services in households such as electric lighting; cooking with LPG, kerosene or electricity, instead of wood or coal; coolin air, refrigeration, air-conditioning; etc.
- ★ Greater dependence on monetised formal supply networks to meet the growing energy demand;
- ★ Present urban energy system is inequitable, causing undue hardship to the urban poor;
- ★ Over dependence on personal vehicles on account of separation of places of work from residence;
- ★ Excessive dependence on oil based motorised forms of transport;

★ Increased incomes and better living styles also lead to larger energy use per capita;

★ Increased requirements of commercial fuel for industrial and commercial activities.

Lighting, cooking and water heating are the major domestic activities requiring fuel in urban areas. Energy in the form of electricity is most widely used for various end-uses such as lighting, and for operating electrical appliances such as fans, electric irons, refrigerators, washing machines and others. A number of studies from around the world suggest that a few key factors have a dominant impact on the amount of energy consumed by urban households. The principal determinants of energy demand in urban areas include income, settlement size, family size, the price or personal costs of obtaining fuels and the efficiency of end-use equipment. Most of these factors are interrelated and have major implications for policies to remedy household energy problems.

To establish the relationship between urbanisation and energy consumption pattern in households, presented below is a comparison of the nature of energy consumption among developed and developing countries:

➤ A high correlation exists between useful energy consumed per capita and GNP per capita. However, the correlation between gross energy use per capita and GNP per capita is low.

➤ The correlation between GNP per capita and the level of urbanisation is 0.67 indicating that to some extent, higher level of economic growth implies a higher level of urbanisation.

➤ Lesser developed countries depend predominantly on traditional energy sources (biofuels) as we obtained a negative correlation (-0.74) between biofuels share and GNP per capita.

➤ Correlation between electricity use per capita and GNP per capita is 0.88 indicating greater demand for electricity with rise in income.

Table 2.1. Energy use and its related parameters : comparison between countries

Country	GNP per capita (US$)	Urbanisation	Traditional fuel share	Electricity per capita	Per capita energy use in households	
					Gross (kgoe)	Useful (kgoe)
India	260	24	87.2	4	120	21.8
Pakistan	380	29	70.7	6	101	26.3
Kenya	390	15	95.9	4	531	74.2
Indonesia	580	22	84.6	2	342	66.3
Egypt	690	45	19.0	7	69	35.1
Thailand	790	17	83.2	9	274	55.0
Phillipines	820	38	62.7	15	278	83.1
Zimbabwe	850	24	79.4	27	408	89.3
Nigeria	860	21	97.0	5	362	48.7
Ivory Coast	950	42	94.5	6	267	39.1
Jamaica	1330	48	1.4	17	135	80.1
Colombo	1460	65	86.3	31	575	106.8
Republic of Korea	1910	61	57.9	22	960	309.2
Chile	2210	82	43.3	26	193	75.7
Brazil	2240	69	61.1	36	233	71.5
Mexico	2270	68	14.3	35	177	94.1
Argentina	2520	83	19.9	47	340	171.5
Venezuela	4140	84	45.2	81	407	155.9
U.K.	9660	70	0.0	221	989	593.4
Japan	10080	78	0.0	129	550	330.0
France	11680	79	0.0	154	936	561.6
F.R.G.	12460	85	0.0	211	1214	728.4
U.S.A.	13260	78	0.0	496	935	561.0

Source: [TERI, 1989] , Kgoe - Kilogram oil equivalent

Table 2.2. Correlation between GNP per capita and different parameters

PARAMETERS	Correlation coefficient
Useful energy per capita	0.94
Gross energy per capita	0.79
Urbanisation	0.67
Biofuels share	-0.74
Electricity per capita	0.88

Table 2.3 gives the estimates of monthly per capita consumption of different fuels in rural and urban households during 1977-78 based on the NCAER study (NCAER, 1985). In 1977-78, urban households used 14 kg of biofuels per capita per month as compared to 29 kg in rural households. As is evident from the data, this may be due to the substitution of commercial fuels like LPG and kerosene in urban areas for biofuels. Firewood plays an important role in household energy even in urban areas. During 1977-78, firewood met more than half of the total gross energy needs of urban homes - almost the same as in rural areas. In terms of gross energy, the per capita energy consumption in rural areas is 34 per cent higher, compared to that in urban area. this is because of the predominant use of traditional fuels (95 per cent of the total energy) in rural areas. It is a well established fact that such fuels have low efficiency (10 per cent in wood burning chulhas compared to about 60 per cent in LPG stoves). On the other hand, in terms of total useful energy, the per capita consumption in urban areas is 23 per cent higher than in rural areas.

Table 2.3. Urban-rural differences in energy consumption: 1977-78

Fuel	Unit	Energy consumption per capital monthly		Per cent			
		Rural	Urban	Rural	Urban	Rural	Urban
Commercial				4.6	36.7	5.1	56.0
- Soft coke	kg	0.19	2.61	1.0	17.4	3.1	23.2
- Kerosene	kl	0.43	0.97	3.3	10.1	2.6	21.1
- LPG	kg	neg	0.18	neg	2.5	neg	9.8
- Electricity	kWh	0.41	2.92	0.3	3.0	0.4	1.9
Biofuels				95.4	67.0	94.9	44.0
- Firewood	kg	13.17	9.73	54.4	53.6	59.2	35.5
- Agri. residue	kg	4.92	0.67	17.9	3.3	15.6	1.7
- Dungcake	kg	11.08	3.00	23.1	8.4	20.1	4.5
- Charcoal	kg	neg	0.30	neg	1.7	neg	2.3
Gross	MJ	481.90	360.48				
Useful	MJ	44.38	54.43				

Note: neg denotes negligible
Source: [NCAER, 1985]

During the period 1982-83 to 1987-88, there has been a steady shift from non-commercial to commercial sources of energy in urban as well as rural areas in household sector. The share of kerosene and LPG has increased, from 34.9 per cent to 44.5 per cent in the urban areas, and from 4.8 per cent to 9.9 per cent in the rural areas.

Table 2.4. Percentage share of different forms of energy in urban and rural households

FUEL	RURAL		URBAN	
	1982-83	1987-88	1982-83	1987-88
A. Non-commercial	94.5	89.0	58.1	47.5
B. Commercial	5.5	11.0	41.9	52.5
- Kerosene	4.0	8.7	26.5	31.9
- LPG	0.8	1.2	8.4	12.6
- Soft coke	0.7	1.1	7.0	8.0
C. TOTAL	100.0	100.0	100.0	100.0
Source: [Oberoi, 1988].				

Table 2.5. Household energy patterns and city size: 1978-79

Population (in thousand)	Per capita energy consumption (kgcr)	PERCENTAGE OF FUEL SHARE							
		Elec.	Ker.	LPG	Coke	Fire-wood	Bio-fuels	Commer	Non-commer
Over 500	(294)	13.5	28.9	15.6	17.3	17.7	7.4	75.4	24.6
200-500	(275)	9.4	28.6	3.0	14.2	20.7	14.4	66.2	33.8
100-200	(269)	9.2	19.8	7.2	21.3	29.6	12.9	57.5	42.5
50-100	(263)	8.0	18.7	6.4	22.5	31.8	12.6	55.6	44.4
20-50	(243)	6.3	9.5	2.9	18.8	38.6	23.9	37.6	62.5
Under 20	(243)	6.7	16.6	1.5	14.3	32.9	28.2	39.1	60.9
Source: [TERI, 1985]									

In 1983, the average per capita monthly expenditure on energy in urban areas (Rs.11.40) was 40 per cent higher than the corresponding expenditure in rural areas (NSSO 1985). However, the share of energy expenditure in total expenditure is about the same in rural and urban areas. The poor households in urban areas spend much less on energy, but their expenditure share on energy accounts for a significant portion (14 per cent of the total household expenditure) as compared to the upper income group (4 to 6 per cent). According to a NCAER study, the larger the urban settlement, the more developed are the distribution and marketing systems of LPG and kerosene. Table 2.5 presents the share of energy use of different sizes of urban settlement. At the same time, in smaller settlements biofuels have been found to be more readily available. However, urban slums are exception to this general trend.

In 1983-84, the NCAER conducted a large nationwide urban household survey comparable with its earlier, 1978-79 survey (Leach, 1987). Considerable changes occurred in the mix of fuels in urban households for cooking and heating during this five-year interval. This was primarily due to kerosene and LPG becoming cheaper, compared with woodfuels. Table 2.6 summarizes these changes:

Table 2.6. Fuel shares for cooking and water heating by income

Energy source	Year	Income groups (Rs per annum per household)					
		Upto 3000	3000-6000	6000-12000	12000-18000	Over 18000	All
Firewood	1979 1984	60.0 53.5	40.0 30.8	25.1 17.9	17.4 9.9	12.1 9.6	42.4 27.4
Soft coke	1979 1984	12.8 6.4	20.2 18.0	23.6 17.9	16.7 15.2	17.3 8.3	18.4 15.3
Kerosene	1979 1984	13.2 23.8	21.3 36.9	21.5 40.2	22.0 38.2	18.9 32.8	18.7 35.7
LPG	1979 1984	0.8 1.2	4.6 4.6	14.2 15.7	26.9 27.9	32.9 39.3	6.6 11.5
Others	1979 1984	13.3 15.2	13.1 9.7	15.6 8.3	17.0 8.8	18.8 10.1	13.9 10.1
(Thousand households)	1979 1984	(7286) (4885)	(9895) (9298)	(4792) (9742)	(611) (2598)	(524) (1193)	(23108) (27716)

Notes: Shares are on a coal replacement basis for cooking and heating

Note: (Leach, 1987)

Above data reveals the following :

- A substantial switch away from firewood, mostly to kerosene and bottled gas (LPG). In total, the firewood share fall from 42 per cent to 27 per cent, with every income group experiencing a drop. The fall was least for the lowest income group (11 per cent, from 60 to 3.5 per cent), but was progressively greater for higher income ranges.

- Other fuels, which refer to crop residue and electricity, also dropped, as did soft coke. The substitute fuels were kerosene and LPG, whose shares roughly doubled; kerosene from 19 to 36 per cent and LPG from 6.6 to 11.5 per cent.

- Importance of kerosene increased quite evenly across all income groups but LPG was mainly confined to the higher income range.
- There was a shift in the distribution of urban households across income groups, with increase in the share from middle to high income groups and decrease in the share of the lowest income group.

The problems faced by urban poor have not been given due attention. The energy consumption in urban poor households is between 1256 and 2053 kJ per capita per day of 'useful energy'. This is much lower than the minimum requiremtns of 2847 kJ, worked out by the Advisory Board on Energy, Government of India (GOI, 1985). In particular, the consumption of lighting is very low since a majority of them use kerosene lamps. In urban areas, poor households are still heavily dependent on biofuels - mainly fire wood, the price of which has increased steeply (nearly fourfold between 1983 and 1985).

Table 2.7. Household energy consumption in selected cities

Cities/Towns	Population	Useful annual per capita total energy consumption (MJ)	Annual per capita electricity consumption (kWh
Delhi	5729	1193	612.0
Madras	4289	1137	340.0
Pune	1685	1008	129.6
Jaipur	1015	1010	330.0
*Jabalpur	757	1083	256.0
Solapur	514	802	147.6
Nanded	191	788	98.4
Satara	84	922	117.6
Srirampur	55	842	110.4
Talegam	22	821	62.4
Junnar	18	1092	68.4

Source: [TERI, 1989]

A look at the results of some recent studies carried out at the city/town level to supplement the findings at the macro-level presents the variation in household energy consumption in different size cities. Data reveals that there is an annual variation from 788 MJ in Nanded to 1193 MJ in Delhi in terms of total per capita useful energy consumption in the domestic sector. Variation in electricity consumption is quite evident. A metropolitan city like Delhi consumes 612 kWh per capita annually - nearly ten times the level in a small town like Talegam and Junnar.

Table 2.8. Per capita consumption of different fuels by income classes

(All India urban)

Income class in Rupees	LPG	Kerosene	Soft coke	Firewood	Dungcake	Electricity	All together		Efficiency of utilization (%)
Upto 500	227 (5.2)	675 (15.3)	134 (3.0)	2552 (57.8)	419 (9.5)	405 (9.2)	4412 (100)	131 3	(30)
500-1000	533 (12.4)	735 (15.9)	286 (6.4)	2249 (50.3)	211 (4.7)	460 (10.3)	4474 (100)	154 7	(35)
1000-1500	828 (17.9)	642 (13.9)	413 (8.9)	1801 (38.9)	275 (5.9)	669 (14.5)	4628 (100)	185 5	(40)
1500-3000	1370 (35.7)	474 (12.4)	118 (3.1)	653 (17.0)	24 (0.6)	1196 (31.2)	3835 (100)	237 3	(62)
3000-4500	1970 (46.7)	193 (4.6)	18 (0.4)	219 (5.2)	5 (0.1)	1817 (43.0)	4222 (100)	313 0	(74)
4500-6000	2113 (43.6)	182 (3.8)	20 (0.4)	281 (5.8)	177 (3.6)	2071 (42.8)	4844 (100)	349 4	(72)
Over 6000	2111 (35.1)	120 (2.0)		149 (2.5)		3635 (60.4)	6015 (100)	498 2	(83)
All together	1285 (29.8)	469 (3.8)	166 (3.8)	1041 (24.2)	115 (2.7)	1235 (28.6)	4311 (100)	243 3	(56)

Note: Figures in parentheses denote percentage values

Table 2.9. Percentage share of energy consumption for different end-uses by income categories (All India urban)

Income class in Rupees	Cooking	Water heating	Space heating	Space cooling	Lighting	Others
Upto 500	78.9	9.8	-	2.6	6.3	2.4
500-1000	78.5	9.1	0.1	3.0	6.1	3.2
1000-1500	72.7	10.4	0.4	4.4	7.4	4.7
1500-3000	61.3	7.9	0.8	7.9	12.4	9.7
3000-4500	52.2	8.5	1.3	12.1	13.7	12.2
4500-6000	50.9	11.7	1.6	11.1	13.9	10.8
Over 6000	36.7	13.5	6.3	12.0	19.8	11.7
All together	62.1	9.7	1.1	7.5	11.3	8.3

Table 2.10. Percentage share of fuel mix pattern for different end-uses (All India urban)

Income class in Rupees	Cooking	Water heating	Space heating	Space cooling	Lighting	Others
LPG	47.07	11.60	-	-	-	-
Kerosene	12.55	23.21	-	-	7.90	-
Soft coke	5.01	3.27	-	-	-	-
Firewood	31.55	33.93	-	-	-	-
Dungcake	3.21	4.46	-	-	-	-
Electricity	0.51	23.50	100.00	100.00	92.10	100.00

Table 2.11. Percentage share of energy consumption across different end-uses (All Ihdia urban)

Income class in Rupees	Cooking	Water heating	Space heating	Space cooling	Lighting	Others
LPG	96.29	3.71	-	-	-	-
Kerosene	71.24	20.58	-	-	8.18	-
Soft coke	90.76	9.24	-	-	-	-
Firewood	85.62	14.38	-	-	-	-
Dungcake	82.14	17.86	-	-	-	-
Electricity	1.00	7.60	25.27	3.79	34.69	27.60

Table 2.12(a). Energy demand projections in urban households

Income class in Rupees	Distribution of households (%)	All India urban population excluding slums (million)		Annual per capita consumption norms					
		1991	2001	LPG (kg)	Kerosene (lt)	Soft coke (kg)	Firewood (kg)	Dungcake (kg)	Electricity (kWh)
Upto 500	2.54	4.09	5.80	5.01	14.71	6.39	129.23	47.01	112.39
500-1000	47.44	76.38	108.26	12.25	15.58	[illegible]	113.88	23.64	127.78
1000-2500	27.58	44.40	62.94	18.32	15.98	19.72	91.21	30.86	185.81
Over 2500	22.44	36.13	51.21	36.04	7.70	3.72	21.50	3.80	445.73
All together	161.00	228.00					-	-	-

Table 2.12(b). Energy demand projections in urban households (continued)

Income class in Rupees	TOTAL REQUIREMENT IN 199						TOTAL REQUIREMENT IN 2001					
	LPG (mt)	Ker (mt)	S coke (mt)	F wood (mt)	D cake (mt)	Elec (TWh)	LPG (mt)	Ker (mt)	S coke (mt)	F wood (mt)	D cake (mt)	Elect (TWh)
Upto 500	0.02	0.06	0.03	0.53	0.19	0.46	0.03	0.09	0.04	0.75	0.27	0.65
500-1000	0.93	1.19	1.04	8.70	1.81	9.76	1.32	1.69	1.48	12.33	2.56	13.83
1000-2500	0.81	0.62	0.88	4.05	1.37	8.25	1.15	0.88	1.24	5.74	1.94	11.69
Over 2500	1.30	0.28	0.13	0.89	0.14	16.10	1.85	0.40	0.19	1.25	0.19	22.83
All together	3.07	2.15	2.08	14.16	3.51	34.57	4.35	3.06	2.94	20.07	4.97	49.00

Table 2.13. Annual domestic energy demand including rural and urban households

	Unit	TOTAL CONSUMPTION - ALL INDIA#			DOMESTIC REQUIREMENT##		
		1987-88	1988-89	1989-90	1994-95	1999-2000	2005-05
LPG	Mt	1.42	1.96	2.27	12.59	17.27	23.70
Kerosene	Mt	7.23	7.73	8.24			
Softcoke	Mt	1.74	1.75	n.a.	9.00	14.00	20.00
Firewood	Mt	n.a.	n.a.	n.a.	n.a.	n.a.	258.90
Dungcake	Mt	n.a.	n.a.	n.a.	n.a.	n.a.	150.53
Electricity	tWh	187.98	187.04	208.08	40.88	82.62	145.61

Note: n.a. denotes not available

Source: # LPG and kerosene from [GOI, 1991]
Soft coke from [GOI, 1990]
Electricity from [CMIE, 1989]

## Projected figures are as per estimates of Planning Commission [GOI, 1986]

It is often difficult to establish the strength of these relationships due to the lack of consistent, comparable survey data based on sufficiently large and statistically valid samples. In India, a study of urban household energy patterns proves to be difficult, since there is no agency collecting the relevant data on a regular basis. The first study in this direction was conducted by the National Council of Applied Economic Research (NCAER), New Delhi. Nearly 4,000 urban households spread all over India were surveyed by NCAER in 1977-78 and a macro level analysis was done, results of which were published in 1985 (NCAER, 1985). At the micro level, a number of city specific studies (based on urban household surveys) have also been done. The cities which have been studied are Hyderabad (Alam, 1985), Bangalore (Reddy and Reddy, 1983), Pune (Nair and Krishnayya, 1985), Raipur (Macauley, 1986), Ahmedabad (Ganapathy and Padmanabhan 1985) and Delhi (TERI, 1990). The Tata Energy Research Institute (TERI), New Delhi also carried out urban household survey in ten cities spread all over the country during 1987 (TERI, 1988). However, no study has been done so far in India to look at the energy needs of urban poor or people residing in urban slums. In this study, an attempt has been made to understand the factors influencing household energy demand in slum areas of Delhi.

Chapter 3

Scope and methodology

Several studies have been conducted on urban slums in India. However, most of them have concerned themselves with the physical planning of these areas. The emphasis has been on providing dwelling units/housing facilities, followed by health and sanitation, and other basic amenities. Energy as a critical input has been a neglected area throughout the development planning process in urban slums, so it is no wonder that in the sphere of overall urban planning also, it has been neglected as well. However energy forms an important ingredient in all aspects of life and hence its requirement is met from some source or the other, no matter what the economic condition of the users is.

Among other things, emergence of slum areas put excessive pressure on household energy scenario in urban areas. There is an acute shortage of basic fuels required for cooking, water heating, lighting entertainment and other uses. Before any attempt is made to prepare any kind of energy plan for slum areas, there is a need to prepare a database information system which is capable of being analysed to understand sector-wise energy conservation, structural changes and inter-dependence for integrated planning of urban slums. Based on this realisation, TERI proposed to develop a comprehensive energy database for the slum areas of Delhi in collaboration with DEDA which would be a step forward in solving the household energy needs in these areas. Since no study has so far looked into this basic need of the urban poor, and because energy needs are now being examined more seriously everywhere, that this study assumes special significance.

3.1 Objectives

The basic objective of the study was to develop a comprehensive energy database for the slum areas of Delhi in the first instance, and subsequently for other parts of the city on selective basis, for comparative analysis. This database would provide detailed information on the amount of a particular energy resource likely to be used to satisfy a specific end-use demand in different economic sectors in the slum areas over a period of time and its integration with the overall urban planning and development process in Delhi. The specific objectives of the study were -

★ to analyse the various factors that influence demand for various types of energy (commercial and non-commercial) in relation to different end-uses in slum areas of Delhi.

★ to extrapolate the total sectoral energy demand and supply scenario for slum areas for 2010 A.D. and to integrate slum energy systems with the overall urban planning and development process to ensure equitable distribution of resources.

Apart from looking at consumption patterns of energy and the changes that have taken place over a period of time, the study also analysed various public policies that would have a bearing on the energy demand patterns in slum areas in Delhi.

3.2 Approach

As per The Slum Areas (Improvement and Clearance) Act, 1956, enacted on 29 December 1956, an area in Delhi can be declared as a slum "Where the competent authority upon report from any of its officers or other information in its possession is satisfied as respects any area that the buildings in that area -

✦ are in any respect unfit for human habitation; or

✦ are by reason of dilapidation, overcrowding, faulty arrangement and design of such building, narrowness or faulty arrangement of streets, lack of ventilation, light or sanitation facilities, or any combination of these factors, are detrimental to safety, health or morals,

it may, by notification in the Official Gazette, declare such area to be a slum area. "In determining whether a building is unfit for human habitation for the purposes of this Act, regard shall be had to its condition in respect of the following matters, that is to say -

✱ repair;

✱ stability;

✱ freedom from damp;

- natural light and air;
- water supply;
- drainage and sanitary conveniences;
- facilities for storage, preparation and cooking of food and for the disposal of waste water;

and the building shall be deemed to be unfit as aforesaid if and only if it is so far defective in one or more of the said matters that it is not reasonably suitable for occupation in that condition."

There are a number of areas in Delhi that would qualify as a slum as per the above definition. These can be broadly divided into the following four categories, (i) the *Jhuggi Jhopri* (JJ) dwellers, (ii) people in the walled city, (iii) resettled squatters, and (iv) residents of unauthorised colonies. However, given the time and financial constraints, it was not possible to study the entire slum population of Delhi, It was therefore decided to concentrate on the poorest section of urban slums (i.e. JJ clusters) as the target group in our research endeavours. As per the DDA records, only the walled city has been notified as a slum area. However, for a variety of reasons, it was decided not to study the walled city area which has already been studied for detailed planning by the Slum Wing of DDA, but instead to focus on the JJ clusters which have sprang up all over this city in the last three decades. The main reasons for choosing JJ clusters, and not the walled city, for the present study are as follows.

➊ The economic condition of the residents of the walled city of Shahjahanabad is not representative of slum areas in Delhi. Although the living conditions are in dire need of improvement, most of its residents are financially capable of bringing about the changes required. Also, all civic amenities including electricity connections are legally provided to this area, which is not the case in JJ clusters or in other slum areas.

➋ The lack of any information or data on unauthorised localities makes it difficult to make these areas as target group in any study.

➌ The poor socio-economic condition of the JJ clusters as well as the fact that it is in these areas where maximum growth has taken place in the last couple of years, makes them ideal for undulating any detailed study. policy prescriptions that is made in regard to slums.

In view of the fact that our study seeks to highlight the energy needs of the urban poor, it was felt that the JJ clusters would be more appropriate than any other slum area in Delhi. But before looking into various facets of JJ clusters, it is necessary to precisely define JJ clusters in order to identify the magnitude of the population living in them. In the present study, the following definitions were adopted:-

Jhuggi Jhopri:	A temporary physical structure used for living or other purposes and made of straw, mud, loose bricks, tin, wood, corrugated sheets etc., without regular foundations. A single *jhuggi jhopri* for enumeration purpose to be identified as a physical structure having separate roof and independent entrance.
JJ clusters:	Ten or more *jhuggis* in close proximity to each other to be identified as independent JJ cluster.

There is no single generic pattern of the JJ clusters concerning their varying size, unorganised nature, the peculiar circumstances of their formation, the duration of their existence, and their different locations in the city. In actuality, they are heterogeneous housing and social units displaying a varied range of socio-economic characteristics and living arrangements.

3.3 Methodology

A study of the energy requirements of the slum areas of Delhi, even while promising to be an interesting study, demands special attention and careful planning. Not only does it involve dealing with a sensitive population about which little is known, estimating its energy needs becomes more difficult task. The methodology adopted for the study was as follows:

1. Sample selection

According to the DDA's slum wing records (which are also the only records available), there are 929 JJ clusters distributed among five zones in Delhi, i.e. East, West, South, North and Central. These clusters accommodate a population of approximately 15 lakh individuals, living in 2,59,344 households. Estimating the energy needs of the entire population was beyond the scope of the present study. Hence, it was decided to select an appropriate sample from this population for detailed analysis.

Sampling theory says that the ideal way to select a sample is to prepare a complete list of all the households, and then select a random or systematic sample from this list. But this is often not a feasible option, cost-wise as well as time-wise. Thus, a sample needs to be selected. This selection process involves picking an appropriate number of clusters (Primary Sampling Unit, PSU) and from these clusters, a select number of households (Secondary Sampling Unit, SSU) for further analysis.

Listing is an essential part of sample selection, particularly in instances, where the population is large and little prior information is available - as is the case in the present study. It is meant to give, besides identification particulars, auxiliary information that can be used to increase the efficiency of selecting the final sample. Such auxiliary information pertains to factors controlling the variation between households. One such variable is household income. It has been shown by numerous studies (NCAER 1985, TERI 1989,) that higher income households exhibit a large variation in both the level and pattern of energy consumption. Hence, if all the households are classified into broad income groups, one would be able to control the variability between the households by including a large number of high income households in the final sample. Further, listing also helps in identifying other such variables which might affect the variability between households, thereby increasing the efficiency of sample selection.

2. Selection of JJ clusters

As PSU in sample selected (the clusters) vary greatly in size (10 households to 9600 households), this would have an adverse effect on the variance of the estimates of the total samples. To optimise this variation in cluster size, therefore, it was decided to sample those clusters with probability proportional to size (PPS). Selection with PPS means, that on an average, a PSU which is, say three times as large as another, will be in the sample three times frequently as the other PSU. This implies that clusters above a certain population may be compulsorily included in the sample. If the variation in the size is moderate, a simple random sampling can suffice.

In the present study, the clusters were divided into four types (I-IV), according to the size. Size here refers to the number of jhuggis in the cluster. The four size classes were Type I, below 500; Type II, 500-999; Type III, 1000-1999; Type IV, 2000 & above.

Similarly, in identifying a JJ cluster, physical boundaries alone did not work satisfactorily. An additional factor taken into account was the identification of the cluster with certain groups of residents. For this purpose, the names given to the clusters by their respective residents have been used. Thus, even when two clusters were separated by a very small physical distance, but had two distinct names, these were treated as two distinct cluster units. However, JJ clusters are so unorganised, and situations so varied, that at times, even subjective decisions had to be made.

Preliminary visits to some of the slum areas have shown that the ***larger sized clusters are more heterogenous*** in terms of income levels and energy consumption patterns. Therefore, in order to make the sample more representative, it was necessary to select a larger proportion of the sample from this category. (This is also in accordance with selection on the basis of PPS, as explained above). Consequently, it was decided to survey all the clusters in Type IV (i.e. 22/22), approximately 50% from Type III (20/41), 25% from Type II (15/61), and 5% from Type I (43/805), adding to a total of 100 clusters which could be representative of urban slums dwellers in Delhi. Table 3.1 shows the zonewise and typewise distribution of the selected 100 clusters. The list of selected cluster is given in Annexure 3.1.

Table 3.1. Zonewise and typewise distribution of selected clusters

Type	ZONE					Total
	East	Central	North	West	South	
IV	2	2	4	4	10	22
III	4	2	6	3	5	20
II	3	2	3	3	4	15
I	4	4	11	10	14	43
TOTAL	13	10	24	20	33	100

3. Survey of the household

The selection of clusters was followed by households identification. These were randomly picked and every fourth, sixth, tenth and twentieth household from each of the four types of clusters was surveyed. Multiplying the average number of households in a cluster type with the number of selected clusters of that type, gave the number of households to be surveyed for that cluster type. For example, if the average number of households in Type I = A, selecting every 4th household in each cluster implies selection of A/4 households from each cluster of Type I. Hence, if B clusters of Type I are picked up, the total number of households of Type I, selected would be B(A/4). Aggregating over all types, the total number of households selected for the present study add up to 9035. Table 3.2 shows the typewise and zonewise distribution of these selected households.

Table 3.2. Zonewise and typewise distribution of selected households

Type	ZONE					Total
	East	Central	North	West	South	
IV	403	255	780	435	1585	3458
III	575	266	748	383	680	2652
II	350	217	322	331	572	1792
I	124	110	309	304	286	1133
TOTAL	1452	848	2159	1453	3123	9035

4. Spatial distribution of slums

Next task was to ensure that selected clusters and households within the five zones were representative of the entire JJ clusters population of Delhi. In other words, to pick these households zone-wise, one has to know the proportional spatial distribution of each type of cluster in the five zones (Table 3.1). A systematic physical scanning of the total area of the Union Territory of Delhi was used for locating the various JJ clusters. The metropolitan area was divided into five zones as delineated in the Master Plan for Delhi. The location of all the clusters were plotted on the map for their precise identification.

On the basis of spatial distribution, selection of the appropriate number of clusters of each type from each zone was made. For selecting the clusters to be visited (having decided on the number to be visited), *average number of households was taken in each type as a guide*. Therefore, if X number of Type I clusters are picked from the North zone, and the average number of households in Type I clusters is Y, those clusters were selected for the survey which had their population as close to Y as possible. Table 3.3 and 3.4 shows the typewise and zonewise distribution of the selected clusters and households vis-a-vis the total number of clusters and households.

Table 3.3. Typewise distribution of clusters and households

Type	Clusters		Households	
	Total	Selected	Total	Selected
IV	22	22	69234	3458
III	41	20	55133	2652
II	61	15	42964	1792
I	805	43	92013	1133
TOTAL	929	100	259344	9035

Table 3.4. Zonewise distribution of clusters and households

Zone	Clusters		Households	
	Total	Selected	Total	Selected
East	123	13	41958	1452
Central	93	10	21877	848
North	227	24	65901	2159
West	204	20	42573	1453
South	282	33	87035	3123
TOTAL	929	100	259344	9035

3.4 Survey methodology

A questionnaire was designed to collect the data related to energy demand and end use pattern in the slum areas. A copy of the questionnaire is given vide Annexure 3.2.

1. Training of surveyors

The surveyors were briefed and provided with introductory letters which also described the purpose of the visit. This helped to build up the confidence of the surveyor and trust among the respondents. Research team members also accompanied the surveyors in each cluster. Depending on the cluster specific characteristics (such as some particular caste dominated occupation dominated, etc.), surveyors were advised to interact accordingly. *Pradhans* were personally contacted in order to get some background information on each cluster.

2. Team selection

Initially a team of two surveyors was used to visit each household. As the surveyors were not familiar with the questionnaire, team of two surveyors proved beneficial. Later on, it was found that they could perform equally well, even individually. It was also observed that the respondent families felt uncomfortable in responding to male surveyors, (more so because during day time only females are at home), a team of a male and a female surveyor was found to be good for interaction with various segments of society.

3. Questionnaires' check

Physical checking for completeness and acceptance of the questionnaire was undertaken every week. This practice was found helpful since it gave a clear picture of the current status of the survey every week. It also improved communication between surveyors and coordinators. Consistency checks which were inherent in the questionnaire design and survey methodology, proved beneficial as it helped in removing the field errors to a great extent.

4. Post-validation

Post-validation of approximately 10 percent of the sample was carried out. The following points were checked for validation.

- ➔ Whether the surveyors actually visited the address specified.
- ➔ Accuracy of the quantified data.
- ➔ Family size and income category.
- ➔ Fuel enduse and appliances

3.5 Drawbacks and limitations of the data

1. Fuel price and quantity

The answers to speculative and interpretative queries which are person-situation-mood-dependant, were found to be not very reliable.

Any answers which demanded accuracy, like fuel quantity and fuel price were also not precise, for the respondent was not aware of exact figures. Sometimes the respondent could give good estimates; if not, the surveyors were trained to make good estimates for prices of a variety of fuels. There was also the problem of variation of prevalent market unit, used in each cluster. We converted them into a standard unit, for instance, number of dung cakes into kilogram weight and number of bottles of kerosene to litres of kerosene.

2. Family income

Respondents were sometimes found hesitant or even reluctant to disclose their family income (especially in higher income cases). The surveyors sometimes had to make a guess from indicators such as house type and ownership, type of furniture and equipments, and also from the number of working members in the family. It needed to be corrected by the supervisors only in very few cases where it seemed too much off the mark from what could be assumed.

3. Enduse-wise fuel demand

It was also observed that respondents were unable to give the enduse wise fuel demand. For example, though everybody was able to give a good estimate of the total quantity of the kerosene used, they could not tell the amount of kerosene used for cooking and water heating separately. This limitation, however, existed only for those fuels which have multiple enduses.

As our final objective was to find out the enduse wise energy demand and the data from the first survey provided information only related to the fuelwise demand per household, it was decided to carry out another survey to develop norms to get the enduse wise information from the data of the first survey itself.

3.6 Second survey

The objective of doing this survey was to develop norms, so as to derive enduse wise energy demand. From the primary data it was clear that kerosene and electricity are the only fuels which have multiple enduses. Kerosene was being used for cooking and lighting whereas electricity was being used for lighting, entertainment, and other uses such as cooling air, etc. Primary data also had information concerning the type of electrical gadgets being used in these slum areas, number of bulbs, type of fan, etc. in each household. It was therefore decided that, for electricity, enduse wise energy demand could be calculated from this information itself. But as far as kerosene is concerned, no information was available (on the appliances) in the primary data. Second survey was therefore carried out to calculate these. A new questionnaire was designed with this specific objective. This is enclosed vide Annexure 3.3. As the amount of kerosene used for lighting would obviously be more in the households not having electricity, availability of electricity was used as a parameter to differentiate between the energy demand of households having electricity with those of not having electricity. The norms developed from the above were used to calculate the enduse wise kerosene demand.

Chapter 4
Data analysis

Most of the JJ clusters visited were inhabited by migrant workers from Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, and in some instances, Tamil Nadu and Kerala. Employment opportunities seem to be the dominant reason for making the shift in residence. Established anywhere between 1947 (as in the case of N-98, which consists of mostly partition refugees) to the mid sixties, these clusters have been growing rapidly over the years.

4.1 Socio-economic profile of slum areas

1. Income distribution

Income, here, refers to the total family income. It is necessary to say a word about the reliability of income data. Most of the people residing in slums are daily-wage earners and have a tendency to report the income on the lower side. However, because of the absence of any other information we had to rely on the reported income levels.

A look at the data collected from these JJ clusters shows the wide diversity in income levels prevailing in these areas. The household income levels ranging from Rs.60 to Rs.11,800 per month, show a highly skewed distribution. The wide range is probably a reflection of the diverse occupation types. These include vendors, masons, domestic servants, cobblers, *and kabariwalas* among others. Most of these people are daily-wage earners which contributes to a high degree of uncertainty in their incomes.

For the purpose of the analysis, population was divided into four broad income categories - (1) upto Rs 750; (2) Rs 750-1500; (3) Rs 1500-2250; and (4) above Rs 2250.

The distribution of households within these income categories is given in Table 4.1. As is clear, the concentration of households is highest in the second category i.e. Rs 750-1500 (61-76% of the households are in this category).

Table 4.1. Income distribution

Income categories	ZONE				
	South	North	East	West	Central
Upto 750	401	186	57	55	47
750-1500	1676	1482	1109	896	482
1500-2250	440	316	315	354	71
Above 2250	251	160	179	171	33
Total	2768	2144	1660	1476	633

2. Civic amenities

While accomadation in most of the clusters is of a temporary type, some residents (usually government employees) have been able to construct *pucca* houses for themselves. In fact, one of the clusters in the north zone, N-74, is composed largely of *pucca* houses.

In the East zone, cluster no. E-24 (Rajiv Camp in Trilok Puri) is another such cluster, where generally *pucca jhuggis* abound. This cluster was also unusual in that it was very clean.

Civic amenities are in a deplorable state, across the board - water and sanitation being the most troublesome. In some cases, the residents have got together and dug a well (N-223), or set up water taps (N-225), entirely on their own strength, in the absence of any support from the municipal authorities. In most instances, overflowing of drains, particularly during the monsoons, complete break down of watersupply, health hazards (resulting from proliferation of mosquitoes) go unchecked. The residents are either completely unaware of public redressal facilities or their pleas go unnoticed. As a result, filth, unhygeinic conditions and diseases abound.

4.2 Energy use

Due to the cultural diversity of the population, in most slums, cooking habits differ. Nevertheless, kerosene stoves predominate as the mode of cooking. This is largely because, being available through the public distribution system, kerosene is cheaper and access to it is relatively easier. However, most people complain of cheating by ration shop dealers, in the sense that most of the time kerosene is not available at ration shops, thus forcing people to buy it from open market where prices are exhorbitant. Invariably, a shortage of kerosene forces them to use either fuelwood, coal (wherever available), and dung cakes. The first two are expensive, so collection from various sources,is usually resorted to. Besides, the obvious financial constraint that prevents the use of fuelwood, lack of space for constructing wood *chulhas*, and a fear of causing fires also inhibits the use of this preferred fuel for cooking.

Electricity is widely used, though not available legally anywhere. (The only exception is the *Pradhan's* house in N-28, who has a metered connection - a rarity in JJ clusters). Electricity is used for a range of end-uses - lighting, heating, cooling air, and mostly entertainment. In most cases, residents use this facility by tapping it from street lights. In some cases, for instance in the east zone, paying for electricity to DESU or the *pradhan* is the exeption rather than the rule (Cluster E-1 was the only cluster found to be paying for it).

1. Energy consumption pattern

The first part of our survey, covered 8681 households spread over 97 clusters all over the city of Delhi. The survey was conducted zone-wise with 34 clusters visited in the south, 24 in the north, 13 in east, 18 in west and 8 in central zone. A list of the clusters visited is given in annexure 3.1. The purpose of this survey, as explained above, is to collect basic information regarding the overall energy consumption pattern in the slums as well as some auxillary information concerning their income levels, family size, and occupation. The analysis of the data collected has been done on two levels: (1) zone-wise and (2) income-wise.

Zone-wise

Although the consumption of energy across zones does not vary significantly, the variation within zones is quite large. Thus, while the zonal variation in average monthly consumption levels for a household is from 299000 kcal in the north zone to 403000 kcal in the west zone (Fig.4.10), the variations within zones is unusually high, as is obvious from the high coefficients of variation observed in the average monthly total energy consumed (0.45 in the East zone to 0.91 in the West zone).

The sources of energy used for cooking, water heating, lighting and cooling include kerosene, firewood, dung cakes, electricity and coal. The average monthly household consumption levels of kerosene range from 17.4 litres in the east zone to 20.2 litres in the west zone, 38.1 kg in west zone to 17.2 kg in the east zone in the case of firewood and from 0.9 kg in the east zone to 3.9 kg in the west zone for coal (Fig 4.1). The consumption of dung cakes, on the other hand, is quite low (9.2 kg) in the west zone and very high in the east zone (28.7 kg) (Table 4.2).

Table 4.2. Monthly fuel consumption in the domestic sector

ZONE	FUELS				
	Kerosene (lit)	Fuelwood (kg)	Dungcake (kg)	Electricity (kWh)	Coal (kg)
South	18.2 (0.51)	28.9 (1.64)	13.2 (3.63)	11.4 (1.39)	1.9 (5.26)
North	20.0 (0.85)	17.2 (1.83)	12.6 (2.38)	19.5 (0.94)	1.5 (9.27)
East	17.4 (0.40)	17.2 (1.47)	28.7 (1.29)	23.0 (0.70)	0.92 (6.96)
West	20.2 (0.72)	38.1 (1.94)	9.2 (3.29)	25.0 (1.89)	3.9 (4.46)
Central	18.9 (0.69)	24.0 (1.58)	7.6 (3.25)	15.2 (0.92)	1.4 (10.0)

Note: Figures in parentheses stand for coefficient of variation.

However, the variation in the amounts of different fuels used within the clusters in each zone is very high (*as against the variation across zones, which is* *insignificant*). This calls for a closer look at the frequency distributions of these fuels. *Kerosene is the most widely used fuel among all users.* Its distribution shows the following pattern, zonewise - kerosene consumption in the range 10 to 20 litres in the south zone is accounted for by 47% of households (i.e. 1299 households). In the north zone, for the same level of kerosene consumption there are 1518 households or 71% of the total population. In the east zone 1190 households or 72% of its population follow the same pattern. In the west zone, 823 households or 56% of the population consumes between 10-20 litres of kerosene and the central zone shows 456 or 71% of the households consuming between 10-20 litres (Figure in annexure 4.1).

Unlike kerosene, which shows a majority of the population (in each zone) consuming kerosene approximately within a certain range (i.e.10-20 litres), there is no such definite range available for fuelwood consumption. For example, in the south zone, fuelwood consumption is concentrated at two different points - 18-26 kg which has 7.6 % of the households, and then at 34-42 kg with 8.3 % of the households. Similarly in the north zone, 5% consume 10-15 kg, 8.5% consume 20-25 kg and 6% consume 40-45 kg. The rest of the population in each of these cases is erratically distributed at different levels of fuelwood consumption. The same is true for dung cake and coal consummption, too.

In the case of electricity, the distribution is similar to that of kerosene, in the sense that a definite pattern does emerge. In the south zone 26% of the households consume electricity in the range 7-12 kWh and in the north zone 25% use electricity in the same range. The east zone also shows maximum consumption in the range of 7-12 kWh with 28% households consuming that amount. In the west, 25% of the households are found to consume electricity in this range. The central zone shows the maximum concentration with 34% households consuming 7-12 kWh of electricity (Annexure 4.1).

Kerosene is the predominant fuel across all zones, accounting for 56% in the east zone to 67% in the north zone (Fig. 4.9) of the total energy consumption. The next most widely used fuel is fuelwood, showing 19% of total fuel consumption in the east zone and 26% in the west and south zones.

Income-wise

A look at the average energy consumption levels across different income levels (Tables 4.3 to 4.7) shows a consistent increase with incomes in all zones except North and Central.

Table 4.3. Average monthly household energy consumption (South zone)

(In '000 kCals)

Income categories	ck	cf	cd	ce	cc	te
Upto 750	138.3	105.9	17.5	6.9	1.2	269.7
750 to 1500	152.7	130.0	24.0	9.2	4.9	317.7
1500 to 2250	166.3	177.3	31.9	11.7	4.1	391.4
Above 2250	181.6	173.6	66.3	15.0	6.2	442.7

Table 4.4 Average household monthly energy consumption (North zone)

(In '000 kCals)

Income categories	ck	cf	cd	ce	cc	te
upto 750	140.2	39.0	15.5	12.5	0.48	207.6
750 to 1500	164.9	84.4	27.1	14.9	3.2	294.4
1500 to 2250	207.0	102.3	39.9	24.7	3.3	377.1
above 2250	190.0	55.0	13.4	24.3	11.1	293.8

Table 4.5. Average household monthly energy consumption (east zone)

(In '000 kCals)

Income categories	ck	cf	cd	ce	cc	te
upto 750	132.6	58.1	64.8	14.3	0.0	270.0
750 to 1500	144.7	79.2	62.1	18.1	2.5	306.6
1500 to 2250	152.9	88.5	60.4	22.8	1.7	326.0
above 2250	172.2	85.4	55.6	26.8	1.2	341.1

Table 4.6 Average household monthly energy consumption (west zone)

(In '000 kCals)

Income categories	ck	cf	cd	ce	cc	te
upto 750	157.4	54.3	2.2	10.6	7.7	232.2
750 to 1500	162.4	150.8	19.6	19.1	6.1	358.0
1500 to 2250	177.4	237.9	23.2	23.8	14.5	476.8
above 2250	220.1	244.9	18.2	33.0	13.8	529.9

Table 4.7. Average household monthly energy consumption (central zone)

(In '000 kCals)

Income categories	ck	cf	cd	ce	cc	te
upto 750	120.0	126.1	11.3	11.1	0.0	268.4
750 to 1500	152.5	112.7	16.6	13.2	1.8	296.8
1500 to 2250	219.8	131.7	19.7	14.7	11.7	397.6
above 2250	234.1	54.1	9.1	10.3	10.5	318.1

Note: ck - Calorific value of kerosene
cf - Calorific value of fuelwood
cd - Calorific value of dungcake
ce - Calorific value of electricity
cc - Calorific value of coal
te - Total energy

Analysing on the basis of these categories, we find that across all zones, with the exception of the north zone, kerosene consumption increases with income (see Fig. 4.2 to 4.6). In the case of fuelwood, the consumption increases with income upto the income level of Rs 2250, and then dips, for instance, in the central zone, the average monthly household consumption of fuelwood increases from 126.1 thousand kCals to 131.7 thousand kCals upto the income level 1500 - 2250, and then drops to 54.1 thousand kCals for the category 2250 and above. This is true for the other zones as well, with the exception of the west zone, where the consumption consistently increases. In the case of dung cakes also, the consumption pattern is similar in that it rises upto the income level of 2250, beyond which it falls. This is true of all zones except the east zone where dungcake levels decline continuously with increasing income. This is probably because dung being an inferior fuel, in higher income households it gets substituted with kerosene, which is the more favoured fuel.

The consumption of electricity increases with income in all zones, except the central zone. This could be explained on the grounds that as income increases, a household's capacity to purchase various electrical gadgets also increases and as electricity is used free of charge, in these areas, people use these gadgets freely without exercising any restraints.

4.3 End-use wise energy consumption pattern

Fuels such as dung cakes, fuelwood and coal are used for cooking and water heating only. On the other hand, some energy sources are used for meeting more than one end-use requirement. These include kerosene and electricity. Kerosene is used for cooking as well as for lighting. Similarly, electricity is used for lighting, space heating and cooling and operating gadgets like television, VCR, and transistors. An analysis of the end-use wise energy consumption pattern of these sources of energy is given below.

1. Kerosene

The primary survey results give the total kerosene used for meeting cooking and lighting demand. To estimate the amount of kerosene used for lighting, another survey was carried out in 100 households that were picked up randomly. However, care was taken to choose households such that the variation in the appliances used for lighting could be captured. This was necessary for the simple reason that different appliances used for lighting have different combustion and hence different lighting efficiencies. This survey was carried out in 5 different clusters, one in each zone. Moreover, the survey was carried out in both types of clusters--electrified and unelectrified. For obvious reasons, in the electrified clusters the kerosene consumption on lighting would be much lower than in the unelectrified ones. The average kerosene consumption on lighting was found to be 22 % of the total kerosene consumption, in the un-electrified households, and only 6 % in the case of electrified households. These norms were then used to calculate the amount of kerosene used for cooking and lighting. The average monthly kerosene consumption for lighting, at the household level, ranges from 1.20 litres in the east zone to 2.28 litres in the south zone. The consumption of kerosene for cooking is much higher. The average monthly consumption for a household ranges from 15.88 litres in the south zone to 18.73 litres in the west zone (Table 4.8). The unelectrified households use a variety of appliances for lighting such as *diyas*, lanterns, wick lamps, etc. The unelectrified households also possess one or more of such lighting appliances which is used in cases of emergency.

Table 4.8. Average monthly household kerosene consumption for cooking and lighting

Zone	KLight (lit)	KCook (lit)
South	2.28	15.88
North	1.90	18.07
East	1.20	16.21
West	1.45	18.73
Central	1.76	17.14
Note: KLight - Kerosene consumption for lighting. KCook - kerosene consumption for cooking.		

2. Electricity

Information pertaining to lighting appliances like bulbs, tubelights and gadgets like transistors, television and VCRs is available from the primary survey. Based on assumptions about the number of hours an appliance or a gadget is run in a day, total kWh requirement has been worked out for each. A variety of gadgets and appliances are used in the slums for meeting several end uses. These include bulbs and tubelights for lighting, televisions, VCRs, radios, and tape-recorders for entertainment and heaters,fans and coolers for space heating and cooling, respective ly. Table **4.9** shows the usage of electricity for these end-uses. A break-up of electricity used for the end-uses - lighting, heating and cooling and entertainment (Tables 4.10-4.12) across the income categories-- shows that in all the zones the electricity used for these end-use increases with income (Figure 4.8). For instance, in the case of east zone, the average household consumption of electricity is 7.4 kWh in the income category upto 750, and increases to 8.4 kWh in the income range 750-1500, 9.3 kWh in the income category 1500-2250 and to 11.5 kWh for income higher than 2250. Similarly, consumption for heating and cooling increases from 8.3 kWh in the lowest income category to 9.3 kWh in the next income category to 14.0 kWh in the highest income category. For entertainment too, the average consumption of electricity increases continuously from 1.54 kWh in the lowest income class to 5.38 kWh in the highest income class. The same is true for the other zones also.

Table 4.9. Average monthly household electricity use for lighting, heating, cooling and entertainment.

(In kWh)

Zone	LGT	HTCL	ENT
South	4.70	7.07	2.11
North	7.86	9.93	2.60
East	8.98	10.22	3.86
West	9.06	9.68	4.91
Central	6.95	6.15	1.79

Note: LGT - Lighting; HTCL - Heating & cooling;
ENT- Entertainment.

Table 4.10. Average monthly household electricity use across income categories (east zone)

(In kWh)

Income class	LGT	HTCL	ENT
Less than 750	7.40	8.30	1.54
Greater than 750 and less than 1500	8.39	9.27	3.44
Greater than 1500 and less than 2250	9.29	10.88	4.45
Greater than 2250	11.50	14.00	5.38

Note: LGT - Lighting; HTCL - Heating & Cooling;
ENT- Entertainment.

Table 4.11. Average monthly household electricity use across income categories (central zone)

(In kWh)

Income class	LGT	HTCL	ENT
Less than 750	5.90	4.92	1.38
Greater than 750 and less than 1500	6.98	6.31	1.79
Greater than 1500 and less than 2250	7.90	7.62	2.48
Greater than 2250	7.08	4.00	1.48

Note: LGT - Lighting; HTCL - Heating & Cooling;
ENT - Entertainment.

Table 4.12. Average monthly household electricity use across income categories (south zone)

(In kWh)

Income class	LGT	HTCL	ENT
Less than 750	3.71	6.92	1.42
Greater than 750 and less than 1500	4.77	7.20	2.04
Greater than 1500 and less than 2250	5.48	6.84	2.85
Greater than 2250	6.43	7.97	3.40
Note: LGT - Lighting; HTCL - Heating & Cooling; ENT- Entertainment.			

4.4 Future trends

The growth of squatter communities is a result of two processes - expansion of the old squatter settlements and formation of new ones. During the period 1951-1973, squatter settlements have grown at an annual growth rate of 11.8% (T.K. Mazumdar, 1983, Urbanising Poor) - 67,461 jhuggis have been added due to the formation of new clusters and 61,545 have been added by expansion of already existing clusters. During 1973-1992, settlements have grown at an annual rate of 3% only. If one assumes, that in the future, they will grow at a rate of say 4%, then the total energy required per day for meeting domestic needs (assuming the same fuel mix prevails) would be 5,779, 213 '000 kCals. The consumption of kerosene would be approximately 330,991 litres per day and electricity would be 330,990 kWh per day.

Fig 4.1 Av. monthly fuel consumption
Zone wise

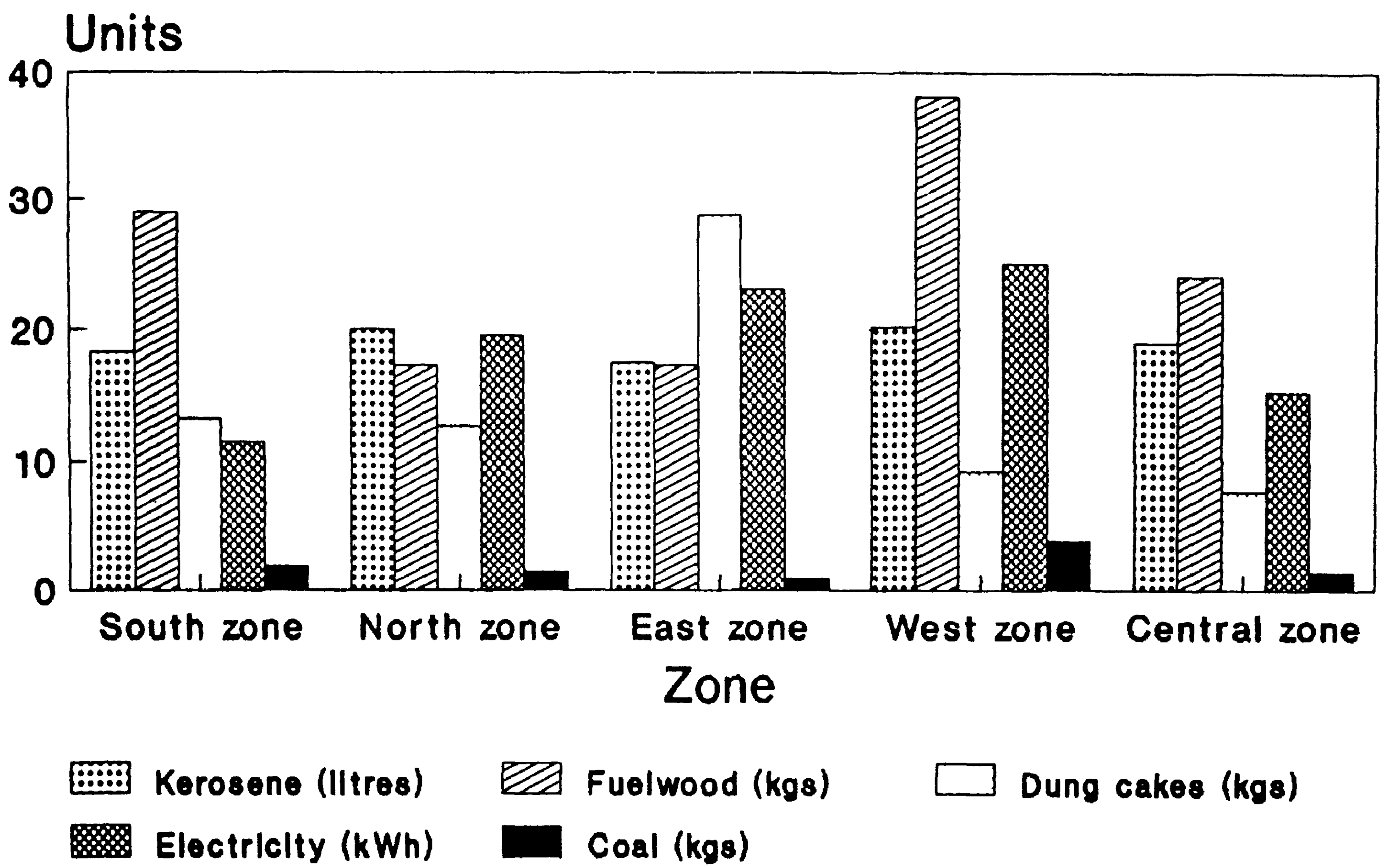


Fig.4.2 Monthly energy consumption
South zone

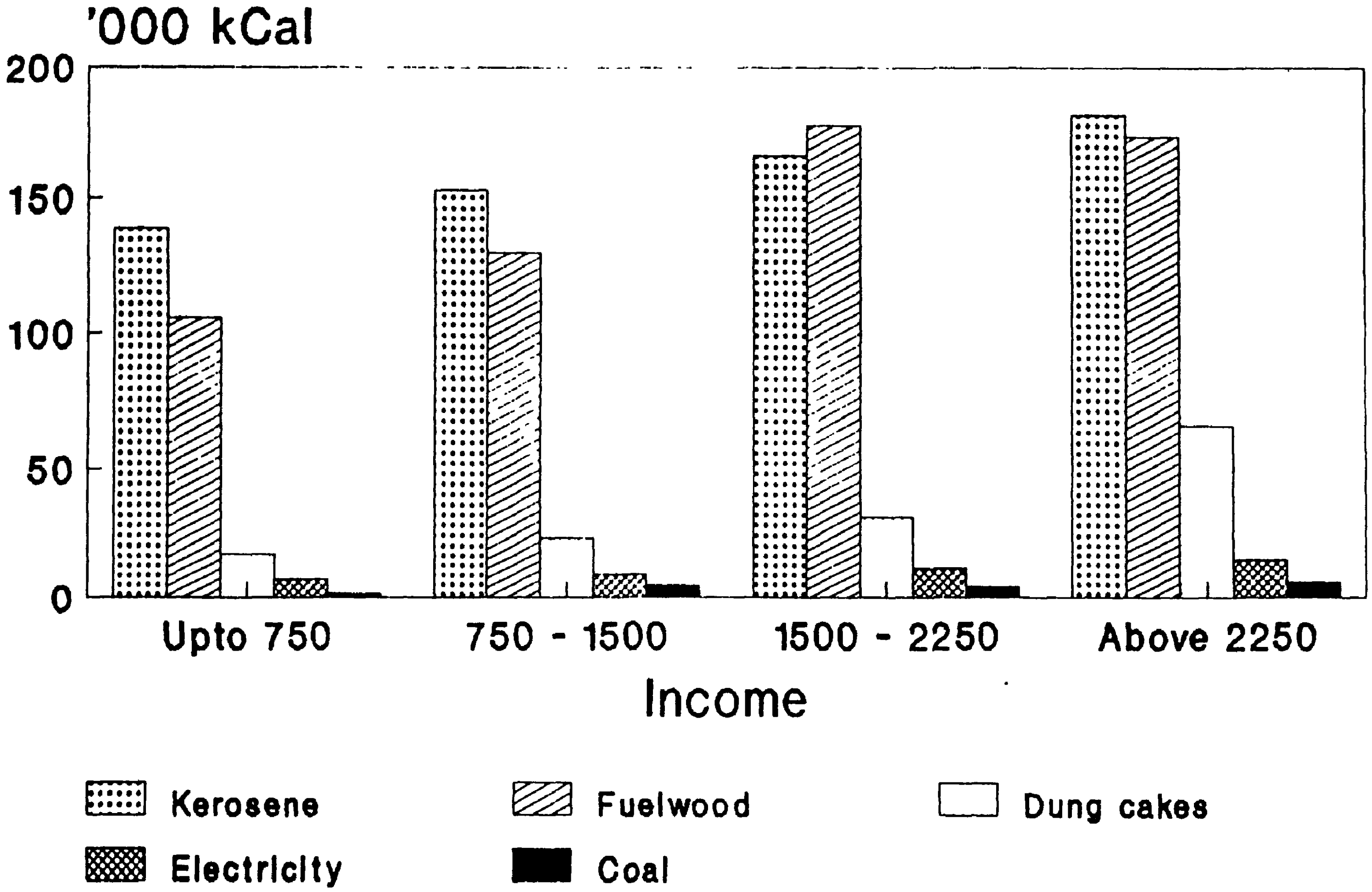


Fig.4.3 Monthly energy consumption
North zone

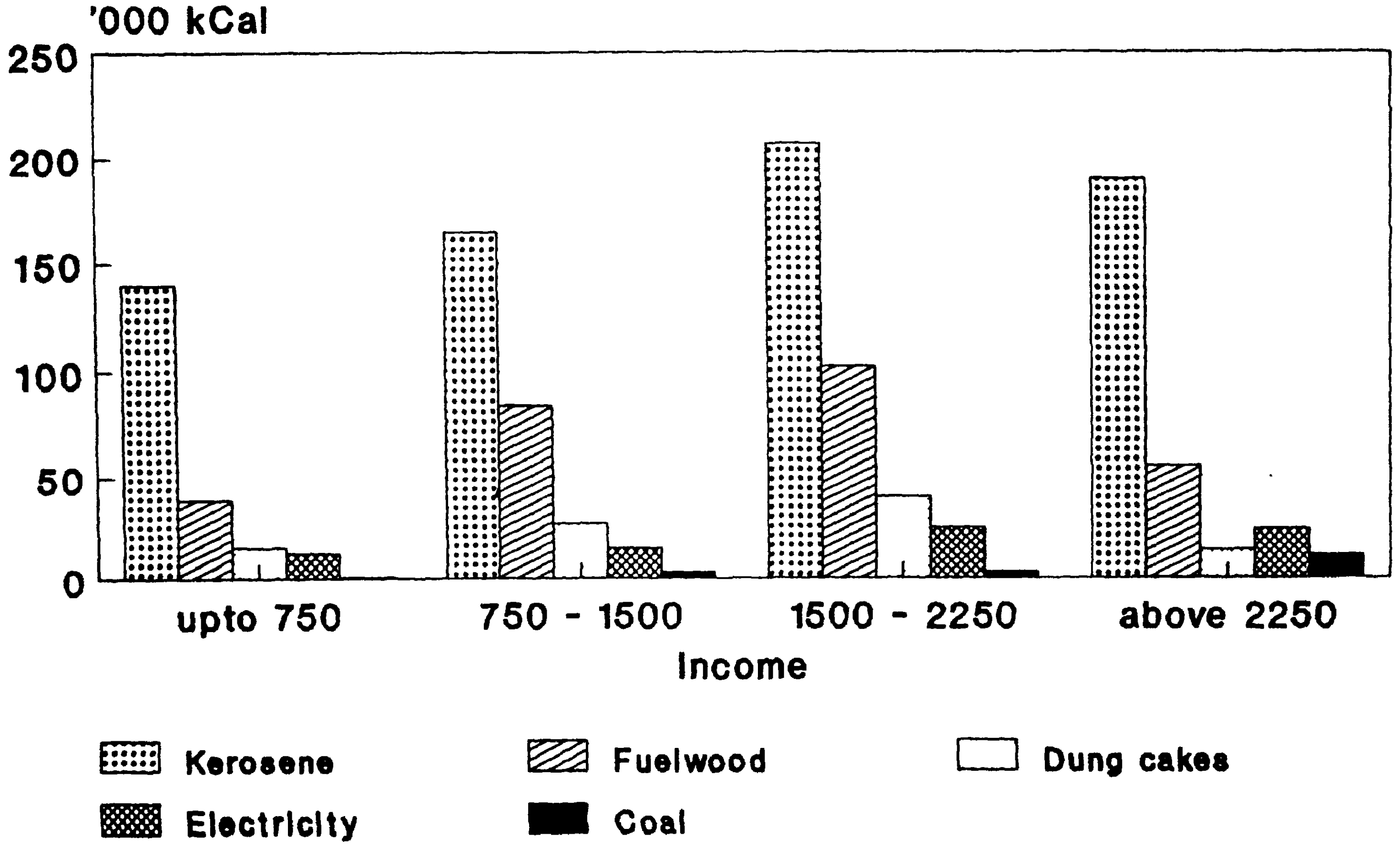


Fig.4.4 Monthly energy consumption
East zone

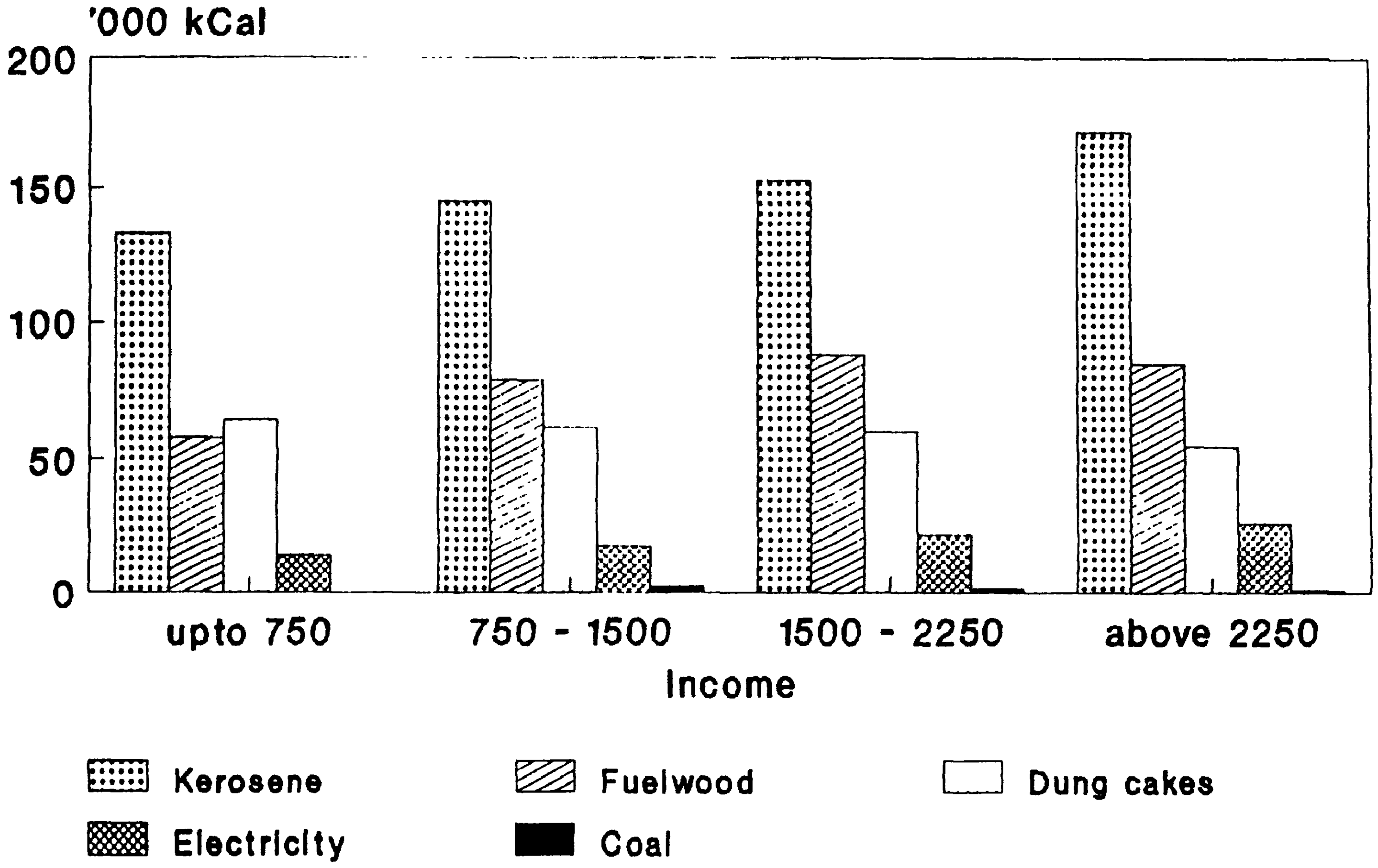


Fig.4.5 Monthly energy consumption
West zone

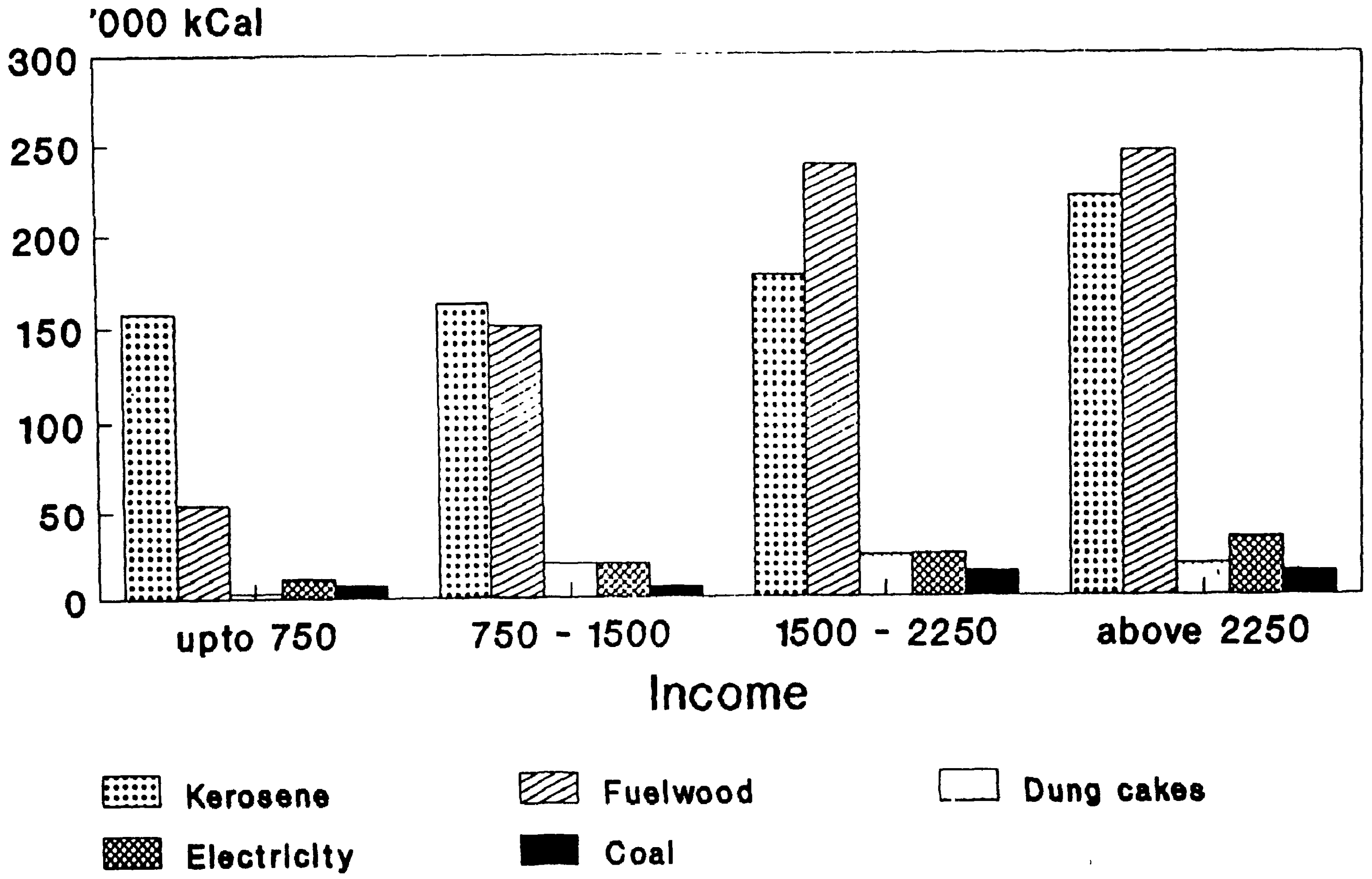


Fig.4.6 Monthly energy consumption
Central zone

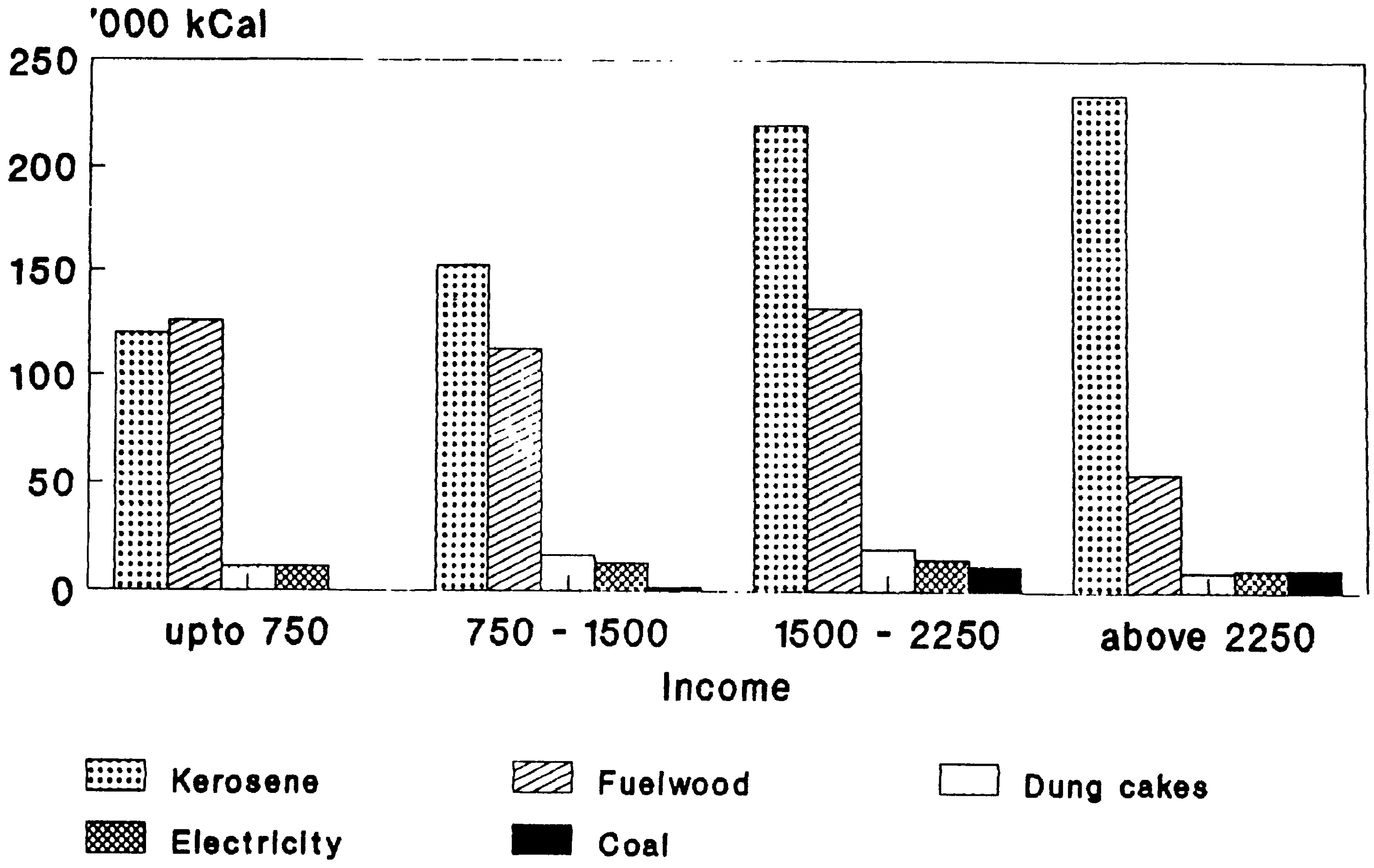


Fig.4.7 Income distribution
Zone wise

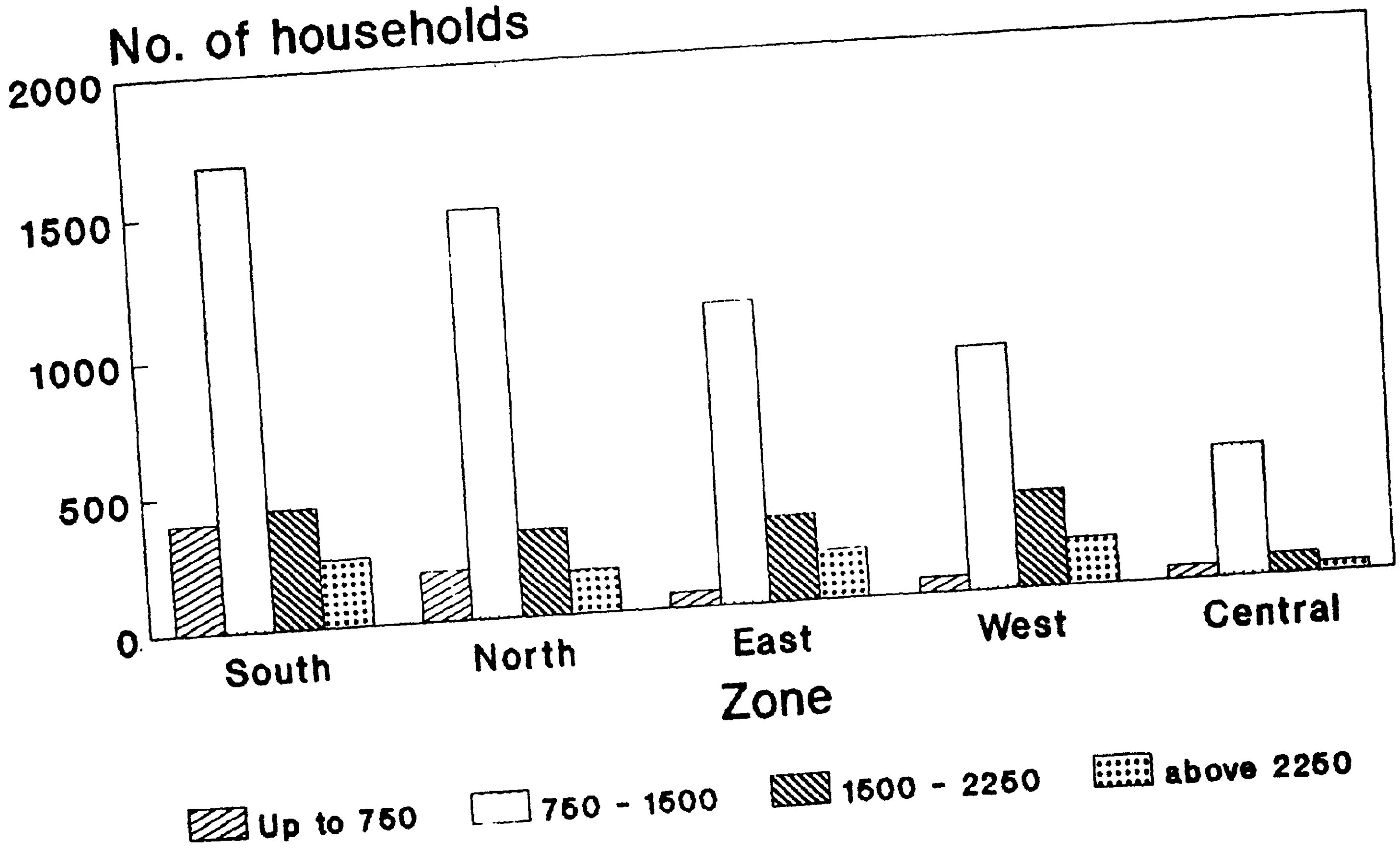


Fig.4.8 Monthly electricity consumption across income classes

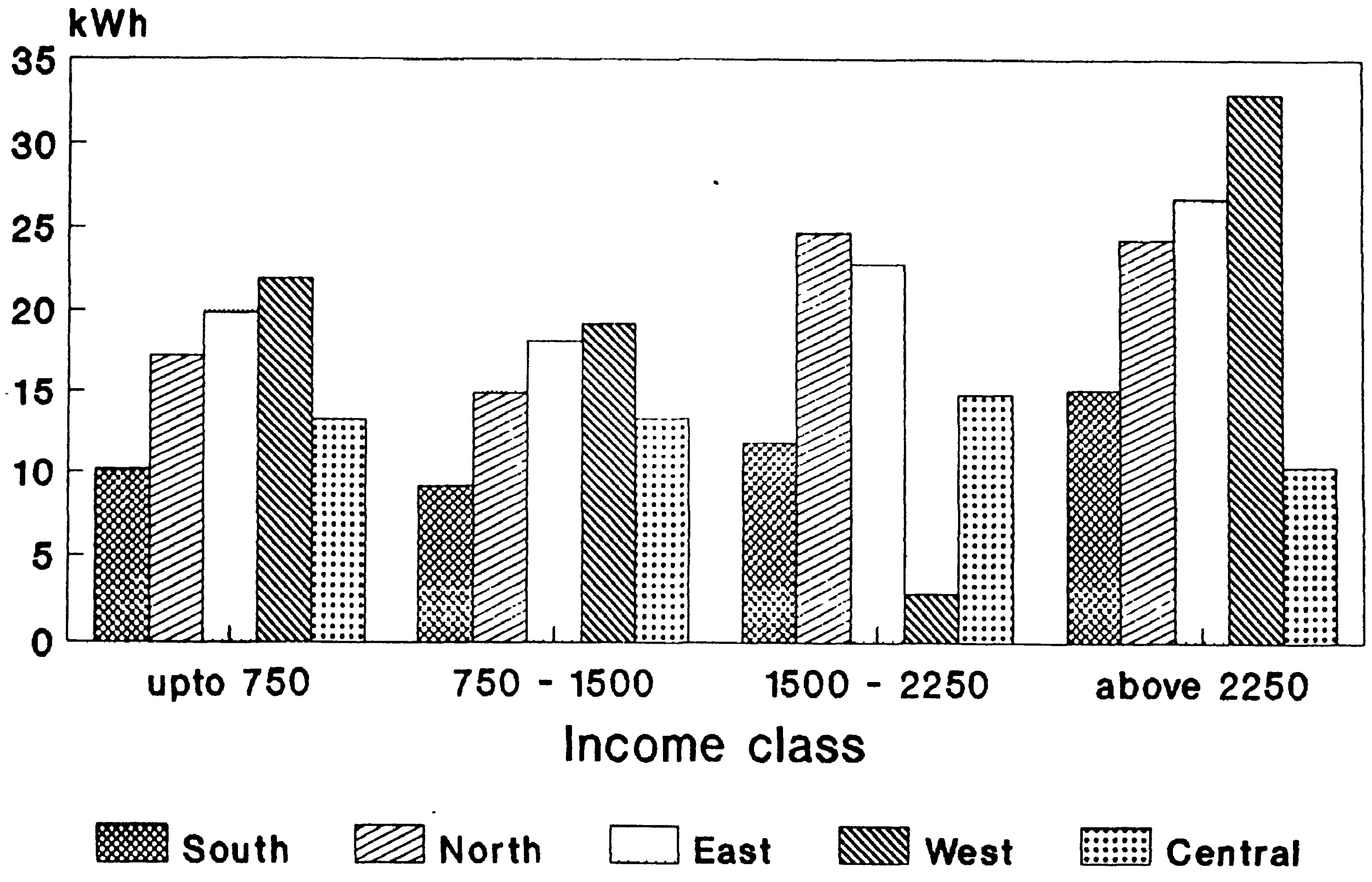


Fig 4.9(a) Fuelmix across various zones

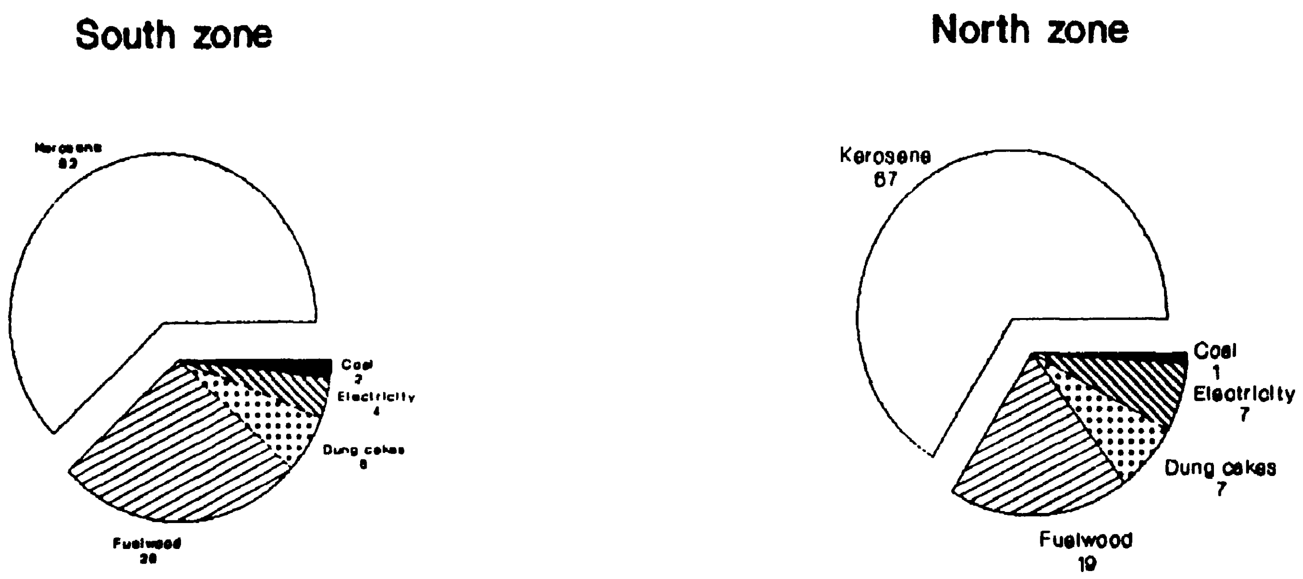


Fig 4.9(b)

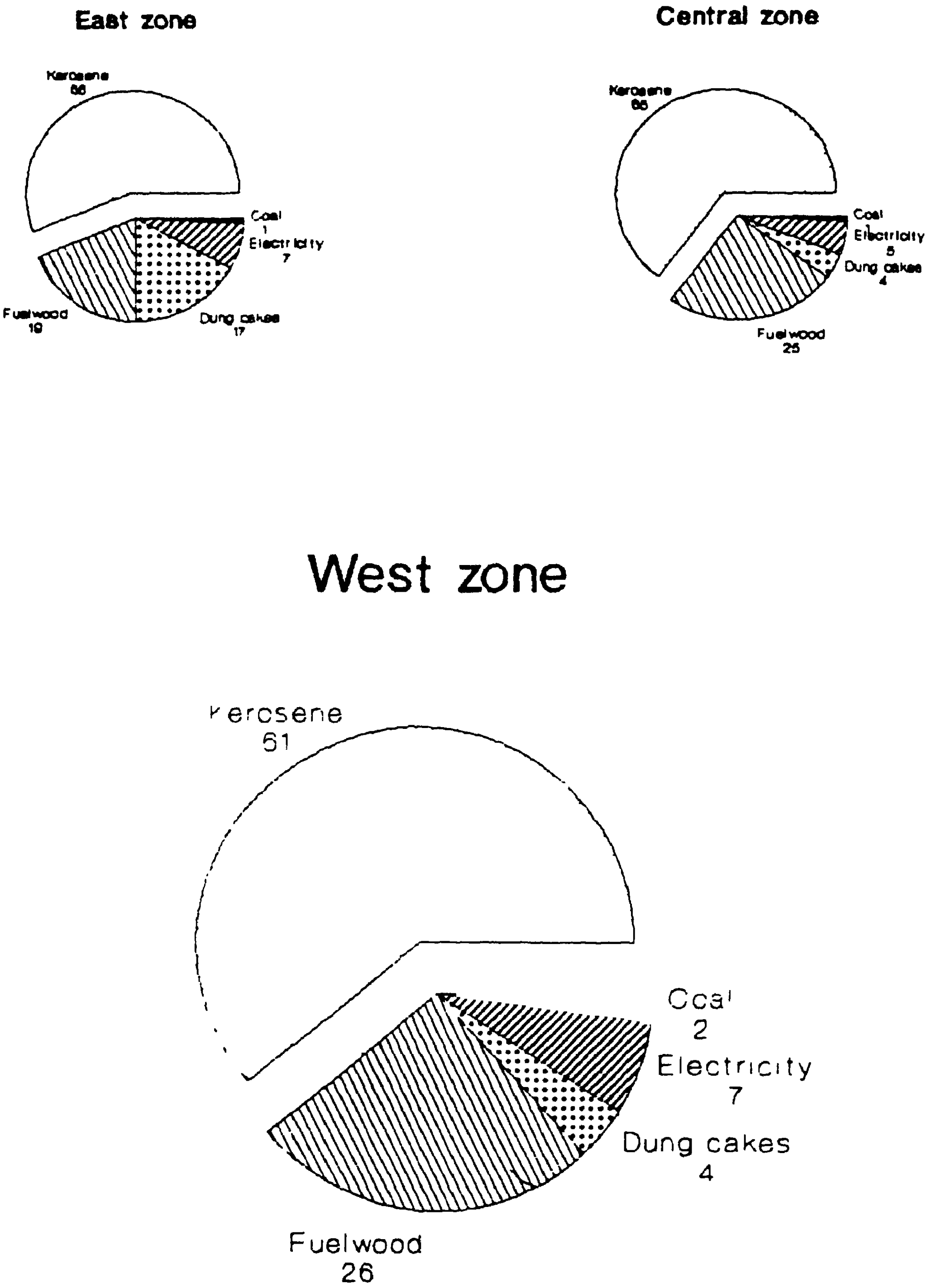
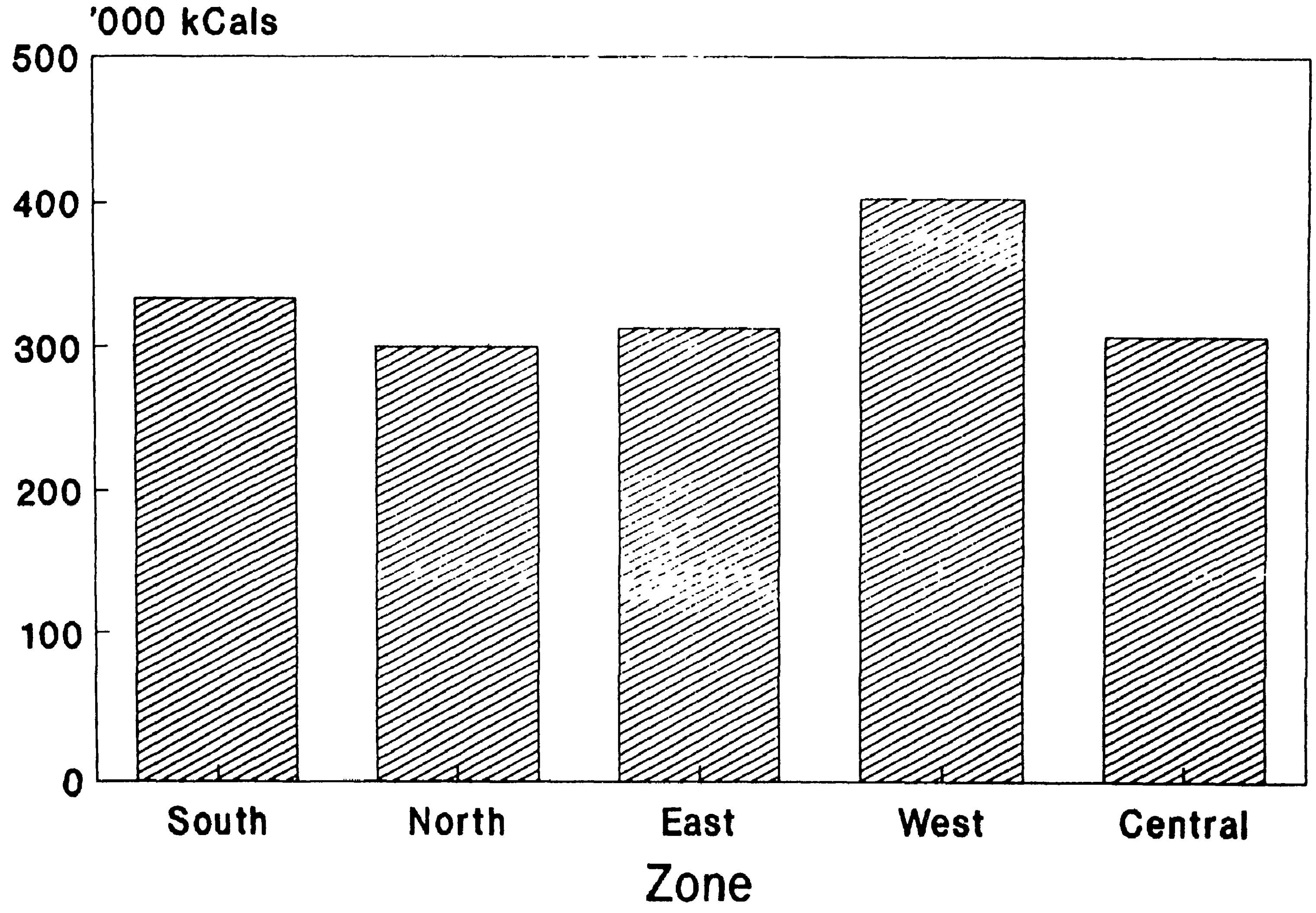

East zone
Kerosene
56
Coal
1
Electricity
7
Dung cakes
17
Fuelwood
19
Central zone
Kerosene
65
Coal
1
Electricity
5
Dung cakes
4
Fuelwood
25
West zone
Kerosene
61
Coal
2
Electricity
7
Dung cakes
4
Fuelwood
26

Fig.4.10 Monthly energy consumption
Zone wise



Chapter 5

Fuel substitution and integration with overall urban development plan

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Major changes in patterns of urban settlements have always involved complementary changes in patterns of energy use. These changes include interfuel substitution, development of new technologies to utilize new fuels, and efficient ways of using old fuel. Urban energy demand substitution could be implemented/attempted at different levels within urban economy. At a general level, this implies a relative decrease in the use of one or more energy sources, with a corresponding relative increase in others. As these are relative changes, fuel substitution also occurs if the use of a given source or form of energy decreases, whether in a specific or general case of improvement of end-use efficiency. Switching could be within renewable and non-renewable sources of energy or within various categories of energy sources. A solution to the energy problems of urban slums requires revised and innovative strategies. Nominal fuel substitution, emphasizing the rational use of non-commercial alternative sources of energy and adoption of new technologies aims at optimizing the use of traditional energy sources. Same is true in case of slum areas of Delhi.

There are variations in the potential supply and need for energy among various JJ clusters of Delhi. Choice of technology and implementation have therefore to be tailored to the specific condition of each slum settlement. Urgent attention is required to be given to ensure an uninterrupted supply of most appropriate energy to meet at least minimum basic needs of slum dwellers. It means quantity of kerosene could be increased to an appropriate level where the switching takes place from traditional fuels towards kerosene. In a similar way, electricity supply could be given to a community/cluster as a whole and flat tariff can be charged on the basis of per capita consumption which has been amply brought out in the present study.

As mentioned earlier, out of the total population of 93.70 lakhs (1991 census) of Delhi, 84.68 lakhs is urban and 9.43 lakhs rural. The density of population in Delhi has increased to 6319 persons per sq.km. in 1991 which is the highest in the country. The increase in population has emphasised radical changes in the urban scenario of this metropolitan city. Consequential results of this rate of increase in population are rapid pace of urbanisation, shortage of dwelling units, mushrooming growth of JJ clusters, encroachment on public land, expansion of unauthorised colonies and creation of more slums. Consequenntly, there is an increasing pressure on civic amenities which are not able to keep pace with the development.

A review of the Seventh Five Year Plan indicates that an expenditure of 31166.09 lakhs was incurred on the urban development in Delhi. Agency/Department wise position of approved outlay and expenditure is as under:

Table 5.1. Expenditure statement on urban development for the VII Five Year Plan

Agency	Seventh Five Year Plan (1990-95)		1990-91 Expenditure
	Approved Outlay	Expenditure	
D.D.A. (Main)	4200.00	1852.46	12.00
D.D.A. (Slum)	9305.00	8783.40	1173.36
L.S.G. (Bus)	-	67.63	108.08
Land & Building	-	-	1.90
M.C.D.	8500.00	19740.55	7898.00
N.D.M.C.	445.00	722.00	171.00
Total	22450.00	31166.09	9362.34

There was a special emphasis on slum area development during the Seventh Five Year Plan. In all, 6.13 lakh slum dwellers were benefitted by providing 48 community halls, 12 *akharas*, 30 open air theatres and 8 special welfare centres along with other basic facilities under the scheme for 'Environment improvement in slum areas'. There was a special programme for environmental improvement in JJ clusters in which 10 lakhs JJ dwellers were benefitted by providing 121 *Jan Suvidha* Complexes, 1400 water hydrants and other basic facilities.

In Eighth Five Year Plan (1992-97), an amount of Rs.900 crores has been proposed which also include Rs.170 crores for annual plan 1992-93. The break-up for the annual plan outlay for 1991-92 and 1992-93 is as under:

Table 5.2. Budget allocation in the VIII Five Year Plan

Name of the agency	Approved outlay (1991-92)	Proposed outlay	
		1992-97	1992-93
D.D.A. (Main)	15.00	-	-
D.D.A. (Slum-I)	1787.00	13150.00	2630.00
D.D.A. (Slum-II)	1425.00	4885.00	967.00
L.S.G. (UBS & NRY)	173.00	1200.00	190.00
Land & Building	5.00	-	-
M.C.D.	7420.00	69965.00	13023.00
N.D.M.C.	175.00	800.00	190.00
Total	11000.00	90000.00	17000.00

Special schemes have been proposed for slum area improvement in Eighth Five Year Plan which are as under:

- Site and services for squatters for self help housing backed by cash construction loan (Rs.12,500.00) relocation of JJ clusters.
- Providing built-up facilities of community halls cum *Baratghars*/social welfare centre/*basti vikas kendras*, recreational facilities, open air theatres in the area under the command of slum wing, DDA (Rs.250 lakhs).
- Establishment of cooperative cell (Rs.25 lakhs).
- Upgradation of slums/JJ clusters and informal shelters by on site relocation of JJ clusters (Rs. 375 lakhs).
- Environment improvement in urban slums (EIUS) (1000 lakhs).
- Redevelopment of *Shahjahanabad* (Rs.50 lakhs).
- Structural improvement and rehabilitation of slum *katras* (Rs.800 lakhs).
- Publicity programme (Rs.25 lakhs).
- Construction of *Jan Suvidha complexes* in the notified slum areas (Rs.500 lakhs).

- Construction of flats at *Mata Sundari* Road and various other places for risky *katra* dwellers (Rs.2500 lakhs).

Delhi Energy Development Agency (DEDA) is responsible for promotion of integrated energy development programme in Delhi. The salient features of DEDA annual plan are as under:

Table 5.3. Salient features of DEDA annual plan

1.	Integrated Rural Energy Programme	Rs.225 lakhs
2.	IREP Training Centre, Bakoli	Separated from DEDA
3.	Energy Plantation in the Union Territory of Delhi	Rs.55 lakhs
4.	Non-conventional Urban Energy Programme	Rs.420 lakhs
5.	Plying of Battery Buses	Rs.300 lakhs
6.	Sanitary Landfill Scheme	Rs.25 lakhs

As is evident from the above, there appears to be no integration or linkages between DEDA plan outlay and overall urban development plan in Delhi. Electricity is being supplied by Delhi Electricity Supply Undertaking (DESU) and any integration with renewable energy programme of DEDA has not been considered. Since DEDA is also a nodal agency for renewable energy programme development in Delhi, it can perform a very crucial role by bridging the gap between the commercial and non-commercial energy planning in Delhi. Some of the areas where this integration could be met (1) Improved chulha programme, (2) Photovoltaic systems for lighting, (3) Community biogas systems, (4) Sulabh shauchalaya and (5) Flat rate tariff for electricity etc. To develop these linkages, further indepth study of energy scenario within slum areas would be required to make a beginning in this direction.

This study is perhaps first of its kind to understand the consequence of energy system/programme in slum areas of Delhi. More specific inputs will be required to come up with specific plan of action to work out various energy demand and supply strategies to ensure hygienic environment and efficient energy use. It is also necessary to ensure equal distribution of energy sources along with improved technologies even if traditional fuels are continued to be used in nearby future.

Rehabilitation of squatters and slum dwellers requires a basic change in orientation. There are many factors which are important to formulate any strategy for rehabilitation of urban slum dwellers. These factors are as follows:

★ The way the urban poor are viewed by politicians, decision-makers and planners has been predominantly negative. Considering slum and squatter areas as a danger to public health and an eyesore (in the inner-city, high-income areas, etc.) is not a correct attitude.

★ Slum dwellers/squatters may not have the legal right to live in those areas, but they have a right to various civic amenities.

★ Slum/squatter areas may occupy potential economically valuable land and rehabilitation would free this land for other forms of urban development provided they are given alternate sites.

★ Slum/squatter areas may require improvement insitu i.e. on the site itself.

★ Voluntary agencies and NGOs can play a very effective role in dissemination of information on energy-environment linkages in slum areas.

Proper institutional linkages, specific plan of activities and emphasis on integrated energy planning are required to solve the energy problems of slum dwellers. It is hoped that this study would lead to integrated energy planning for slum areas in Delhi.

Annexure 1.1

Urban slums and policy planning

As our nation is committed to the welfare of its people, major governmental efforts are aimed at raising quality of life, especially of the weaker sections of society. Consequently continuous attention is paid to the provision of various basic amenities, including housing, drinking water, sanitation, etc. There has been a distinct shift in Government's thinking and approach towards the growth of urban slums in the last four decades.

Growth of urban slums

In the 1950's slums were considered as bad spots in the urban scenario and they were sought to be cleared. The slum clearance scheme introduced in 1956 envisaged rehousing of slum families in new tenements constructed by the state slum clearance boards and housing boards. This strategy did not receive appreciation in view of the excessive cost of such rehabilitation schemes and diversion of resources. Moreover slums were growing at a very rapid rate and their clearance involved substantial social and economic dislocation and hardship to their dwellers. By 1970, it was realised that the dwelling units in slums should also be accepted as a part of urban housing framework. There was an urgent need to improve the environment for the people living in such slums. A scheme for environmental improvement of slums was launched in the central sector in April 1972. Under this scheme, the living conditions in slum areas were sought to be improved by provision of civic amenities such as water supply, sewerage, storm water drains, street lights, community baths and latrines, widening and paving of lanes. Improving of the existing dwelling unit/hut at the site was left to be carried out by the occupier. In the Fifth Plan, provision were made for housing schemes to cater to EWS (economically weaker section) housing, while Government agencies were expected to play the role of providing the necessary infrastructure. Integrated Urban Development Programme (IUDP) launched in the Fifth Plan, was intended to induce State Governments to adopt rational urban and housing

policies and to give special attention to EWS. Environmental improvement of slums was one of the elements of the Minimum Needs Programme also introduced during Fifth Plan. The Sixth Seventh Plans continued this programme with greater vigour and took steps to provide security of tenure to the slum dwellers so that they might develop interest in maintaining and improving their habitat. At the beginning of the Seventh Plan, there were 175 lakh slum dwellers yet to be provided relief under the scheme environmental improvement of slums. Facilities provided under this scheme included improvements in water supply, sewerage, paving of streets, storm water drainage and community latrines. About 90 lakh urban slum dwellers were expected to benefit from this scheme during the Seventh Plan leaving a balance of 85 lakh to be attended. However, this did not come true due to the absence of institutional linkages, required potential and administrative will and people monitoring.

Shelter and development are mutually supportive. Housing forms an important part of the strategy of the Government for the alleviation of poverty and employment generation, and is to be viewed as an integral part of overall improvement of human settlements and economic development. Despite considerable investment and efforts over successive Plan periods, the housing problem continues to be daunting in terms of the large number of homeless households, rapid growth of slums and unauthorised colonies. Spiralling prices and rents of land and houses, rampant speculation, deficient availability of water, sanitation and basic services to bulk of the population also added to the increasing struggle of the poor and vulnerable sections to secure affordable and adequate shelter. The housing shortage is estimated by the National Buildings Organisation, in 1991, to be about 31 million units; 20.6 million in rural areas, and 10.4 million in urban areas. The rapid growth of urban population and its increasing concentration in only some of the cities has led to increasing congestion and overcrowding in small houses, steady growth of slums and informal settlements and severe pressure on civic services. This has been aggravated by institutional deficiencies of housing agencies and local bodies, and insufficient attention to the shelter needs of the poor.

Centrally sponsored schemes for urban slums

There are a number of schemes/programmes which have been launched in last two decades to provide for housing/shelter to urban poor. These are as under:

(i) Pavement dwellers scheme

Under pavement dwellers scheme, 1000 night shelters/Sulabh shauchalayas will be constructed every year. This scheme was introduced to provide shelter to the footpath dwellers and the absolutely shelterless in metropolitan/large cities. Under the Action Plan of the Government announced in January, 1990 the central scheme sought to provide night shelter and sanitation facilities to footpath dwellers at a per capita cost of Rs.5,000 with 20% subsidy from Central Government and 80% loans from HUDCO. On the basis of the recommendation of a Committee Under Secretary (UD), the scheme has now been extended to all urban areas wherever the problem of footpath dwellers exists. As on 30.11.91, a total number of 16 schemes have been sanctioned by HUDCO to benefit 7706 footpath dwellers. Another 51 schemes are under appraisal. It is proposed to review the guidelines of the scheme with a view to generate more schemes during the Eighth Plan.

(ii) Centrally sponsored scheme for integrated development of small and medium towns (IDSMT)

With a view to reduce the migration of population from rural areas to major urban areas; to generate employment by creating resource generating ventures in the small and medium towns and also to provide sufficient infrastructure facilities in these towns so that their hinterland is served better, the Scheme of IDSMT was launched during the Sixth Five Year Plan with an outlay of Rs.96 crores. The scheme continued during the Seventh Five Year Plan with an outlay of Rs.88 crores.

Under this scheme, Central assistance was given to towns where population was less than one lakh during 1981 census for the Sixth Plan and during 1981 census for the Seventh Plan. However, certain towns above one lakh population, as identified by the National Commission on Urbanisation for priority development, were also considered under the scheme during the period.

(iii) World Bank assisted urban development projects

The World Bank (IDA) is assisting various states in urban development programmes. These projects are currently under implementation in the states of West Bengal, Madhya Pradesh, Maharashtra, Gujarat, Uttar Pradesh and Tamil Nadu. Slum upgradation, water supply and sanitation, shelter upgradation, area development, transportation, etc., are the components for which the World Bank assistance has been given.

(iv) Urban poverty alleviation programmes

Urban poverty alleviation is a challenging task before the nation which calls for imaginative new approaches. The goal is to adequately feed, educate, house and employ the large and rapidly growing number of impoverished city dwellers. According to the Seventh Plan estimates, 50.5 million people or 27.7% of the urban population were living below the poverty line in 1984-85. The urban population has increased by 36.19% from about 160 million in 1981 to about 217 million in 1991 further aggravating the scenario of urban employment. The bulk of the urban poor are living in extremely deprived conditions with insufficient physical amenities like low-cost water supply, sanitation, sewerage, drainage, community centres, health care, nutrition, pre-school and non-formal education. A significant portion of the urban poor belonged to scheduled castes, scheduled tribes and minorities. The need of the hour is to assist the urban poor by helping them to set up micro-enterprises thereby providing them avenues for enhancement or supplementation of their incomes. Another major area of assistance to the urban poor is provision of funds for housing or shelter upgradation.

(v) The programme of urban basic services for the poor (UBSP)

The centrally sponsored programme of Urban Basic Services was introduced in 1986 with the assistance of UNICEF for provision of basic social services and physical amenities in urban slums. The programme aimed at convergence of social and physical services rendered by different specialist departments like Health, Education, Social Welfare and Industry/Industrial Training in urban slums with special focus on child and women survival and development through immunization, nutrition supplementation, pre-school and creche facilities and training for income generation in relation to social services and provision of basic physical facilities such as water supply, drainage and low cost sanitation in relation to physical services. The programme emphasised community based management through neighbourhood committees of the urban poor themselves. During 1990-91 the programme was revised and enlarged and came to be known as 'Urban Basic Services for the Poor'. This programme seeks to bring about a functional integration between the provision of social services under UBSP and the provision of physical amenities under the state sector scheme of Environmental Improvement of Urban Slums. The revised programme has enlarged the sheld of social services to be provided to the urban poor by including special inputs tailored for street children, handicapped, aged and destitute on the one hand and for solving socio-economic problems characterising slums, like juvenile delinquency, communalism, gambling and alcoholism on the other hand, The onus of choosing from competing social inputs has been given to the neighbourhood committees of the slum dwellers. Community participation is the foundation on which the programme has been built-up.

(vi) Environmental improvement of urban slums

The Task Force on urban development of the Planning Commission for the Seventh Five Year Plan estimated that the slum population in 1990 will be between 51 to 56 million.

The scheme of Environmental Improvement of Urban Slums (EIUS) was formulated as a response to the growing problem of slums during the Fifth Five Year Plan. The scheme was made an integral part of the Minimum Needs Programme (MNP) in 1974 and was transferred to the state sector. The scheme aims at ameliorating the living conditions of urban slum dwellers and envisages provision of drinking water, drainage, community baths, community latrines, widening and paving of existing lanes, street lighting and other community facilities. The improvements are meant to be carried out in notified slums which are not likely to be cleared within the next 10-15 years.

The target for coverage during the Seventh Five Year Plan period was 9 million slum dwellers. It is heartening to note that this target has been exceeded and 9.98 million slum dwellers have been covered. Against the target of covering 15.40 lakhs slum dwellers during 1990-91, 19.35 lakhs slum dwellers were covered during the last financial year which comes to 125%. The target fixed for the current financial year is 12.96 lakhs slum dwellers against which 10.06 lakhs slum dwellers have been covered upto the end of December, 1991. Further, the per capita expenditure under the scheme has been increased from Rs.300 to Rs.525 and additional inputs pertaining to community facilities, garbage removal and maintenance have been built into the scheme. Moreover, the scheme is now to be implemented in convergence with the programme of Urban Basic Services for the Poor.

(vii) 20 Point Programme and the Ministry of Urban Development

The Ministry of Urban Development was made responsible for monitoring point Nos. 14(d), 14(e) and 15 of the 20-point programme introduced in 1986 in the Government. These related to the housing for the economically weaker sections and low income group in the urban areas under points 14(d), (e) and Environmental Improvement of Urban Slums under point No.15. Besides, two evaluatory items namely 'Use of Low Cost Building Materials under point No.14 and Restrict Growth of Urban Slums under point No.15' were also monitored.

While the monitoring of point No. 14(d), 14(e) and 15 is done on monthly basis, the evaluatory items are monitored on half yearly basis. Since the subject matter of rural housing has been transferred to the Department of Rural Development with effect from 1st April, 1991, monitoring of point Nos.14(a), (b) and (c) relating to Provision of House and construction assistance to rural landless including the artisans and Endure Awas yojana stands transferred. The 20-point programme envisages Government's commitment to eradicate poverty, reduce disparities in income and seeks to remove social and economic inequalities in income and also to raise the quality of life.

All the above mentioned programmes assumed considerable significance in view of the priority accorded under the National Housing Policy for improving access to shelter to the houseless and disadvantaged groups such as SC/ST, widows, economically weaker sections in the urban areas and the manifesto targets for night shelters, expanded housing for SC/ST and backward classes and basic facilities for slum dwellers.

Keeping in view the policies of planned growth of urbanisation, income support and poverty alleviation, and together with steps to arrest the growth of slums in urban areas, the following steps are required to be taken to provide housing for urban poor and avoid forcible relocation or dishousing of slum dwellers.

- Encourage in-situ upgradation, slum renovation, and progressive housing development with conferment of occupancy rights wherever feasible, and to undertake selective relocation with community involvement only for clearance of priority sites in public interest;
- Expand provision of water supply, sanitation and other basic services in slum and other settlements occupied by the poor;
- Ensure proper maintenance of amenities through community involvement and decentralised institutional arrangements;
- Integrate the provision of physical amenities with basic services including maternal and child welfare services and health care, structured on community participation and involvement of voluntary agencies and eyed by local bodies;
- Promote incremental construction and etch by poorer households through access to land and services, through technical support, outlets for low cost technology and materials, opportunities for skill development and access to housing finance on flexible terms;
- Provide night shelters and sanitary facilities for the footpath dwellers and the homeless.

Public policy regarding urban slums

a) Treatment of urban slums in the national plans

At the time of independence, our country was faced with the difficult task of building a nation stripped of much of its traditional wealth. Having opted to follow the path of planned development, a concrete shape was given to the ideologies current at the time, in the form of five year plans. As limited resources did not permit giving equal weightage to all the problems plaguing the country, each plan laid emphasis on what was believed to be the most pressing problem of the time.

In the face of abject poverty, unemployment, food insufficiency, and poor industrial development, urban development and its concomitant problems paled in significance. Consequently, urban planning was not accorded the importance it should have.

In the first five year plan (1951-56), the basic attitude was that congestion and the growth of slums was a temporary problem that could be done away with by simple legislature against slum formation, or at worst removal/relocation of the slums that do get established. Slums were observed to be a 'disgrace to the nation', and therefore to be 'cleared'. The growth of slums was seen as a result of,'laxity in enforcing building regulations, the indifferent attitude, till recently, to conditions of living amongst industrial workers and high land values prevalent in certain cities which let the landlords to exploit their advantage to the fullest'. In essence slums were considered a housing problem, and hence the clearance of slums became a part of a national housing policy.

In the second Plan, (1956-61) which laid out the strategy for long-term planning in India, especially regarding industrial development, a more comprehensive view was taken of the problem of urban development. Planners recognized the unplanned character of urban growth and the need to take a wider and longer term view of the situation. Although slums continued to be considered under the purview of a housing problem, there was a change in the approach. Urban housing was no longer seen as a problem by itself, or as an attempt to continually catch up with events but as a part of the wider problem of the planning of urban areas and of their economic and other relationships with the region in which they were situated.

In recognition of the potential magnitude of chaos, the problem was sought to be rectified in a phased manner by all three levels of government - central, state and local. The centre was to formulate a national housing policy in which low cost housing for the urban poor would form an important part, while the states were asked to prepare master plans for all important towns and the local administration was to increase its efficiency in providing civic amenities to the increasing population of towns.

The third plan (1961-66) marked a further revision in policy towards slums. On recommendation of the Advisory Committee on Slum Clearance and a Study Team set up by the Committee on Plan Projects, it was felt that while long term plans were required, it was even more essential to think of short-term measures to relieve acute distress in the slum areas. As an immediate measure minimum amenities like sanitary latrines, proper drainage, uncontaminated water supply and proper lighting were to be provided. This policies have been continued in consecutive plans and have been re-emphasized in Eighth Plan document.

A review of public policies reveals that the approach so far followed has resulted in little or no improvement in the situation. The Master Plan concentrated only on providing housing of a permanent nature, catering only to the lower-middle income levels. It failed to take into account the fact that a significant proportion of the relevant population was living at subsistence levels and could ill-afford it. Similarly, the resettlement scheme, which was meant to provide squatter families with a developed plot of land containing a latrine, a water tap and a plinth to build a house, has served only to relocate the slums. Lack of adequate provision of services, and their gross neglect resulted in complete failure in the implementation of the scheme. Consequently, not only did the resettlement colonies turn into slums, new JJ clusters could not be prevented from mushrooming all over the city. Hence the city now has 1.2 million people living in sub-standard conditions in the resettlement colonies, in addition to 1.5 million that continues to exist in the JJ clusters. The problem has been further compounded with new migrants into the city moving into the already existing slum settlements forming what is called,'slums within slums'.

b) National commission on urbanisation

The National commission on urbanisation has in its recommendations suggested provision of 50 per cent of the plots of smaller size ranging between 25 sqm. to 100 sqm. for the economically weaker sections and further recommended that land be allotted for housing not to the individuals, but to the cooperative societies. Another important recommendation of the Commission is that "high density with low rise development" is not only more economical solution for development but also satisfies requirements of large sections of the society and is aesthetically satisfying. The high rise and high density development in the form of multi-storeyed flats is neither affordable nor suitable for the life style of the families in our country.

c) Draft national housing policy

Draft national housing policy has emphasised the need for improving the access of slum dwellers to basic services and shelter etch. With regard to resettlement of jhuggies/slum dwellers, it recommends relocation at suitable sites and with the cooperation and acceptability to the community. As a policy, it recommends a minimum size of 25 sqm. plot in urban area which could further be reduced to 20 sqm. in larger cities. HUDCO, on the other hand, has recommended 15 sqm. plots to be developed on "Cluster Court Town House Concept" with a provision for incremental construction on the upper floor and thus making available 30 sqm. of built-up space for each squatter/slum evictee/urban poor.

The Ministry of Urban Development, a few year back, constituted a committee headed by the Lt. Governor of Delhi to monitor the progress of certain important identified projects intended to improve the quality of life of the slum areas of the walled city. The emphasis of these projects was on removal of undesirable activities and to provide for requisite infrastructure and facilities rather than clearance and re-development.

Master plan

Master plan for Delhi, the first comprehensive plan, for the development of the city was promulgated on 1st September, 1962 and has been the frame for guiding developments since then. This Plan remains a unique document, being the first attempt on comprehensive urban planning for the union territory of Delhi. The Plan also provided a useful base for regulating the development and building activity in different urban sectors.

Some basic postulates enunciated by this Plan more than three decades ago, below remain as true today as they were in 1962; intact, they need to be re-emphasised. The salient features of MPD 62 are as under:

- Delhi should be planned in context of its region.
- For balanced development of the city and minimum friction, there should be decentralisation of employment and its right relationship with residential areas.
- While guiding developments in new areas along desirable lines, those areas that have healthy organic pattern must be conserved by checking the encroachment of undesirable and conflicting land uses.
- Delhi is a beautiful city and its pleasing architecture should not confine to the monumental civic and cultural centres but should pervade the design of all public and private buildings.

But as there are a number of stages from the enunciating of planning principles to its accomplishment, all the above postulates during the process needed adequate acceptance, detail planning and execution. Intact, during implementation, they suffered some loss at every stage. The end results in some spheres have not, therefore, been satisfactory. Issues like rapid urban population and employment growth, land use permissibility, land use intensity, informal sector and incompatible uses alongwith lack of will and clear-cut direction, which overwhelmed the Master Plan in the process of its implementation.

No monitoring system can change the socio-economic profile of any urban, unless it is backed by proper institutional linkages. In the absence of any forward-backward linkages, there was no room for quick reactions and adjustments in the planning policies. Thus during plan implementation process, there has been large areas of un-intended and hapzard growth. The developments like unauthorised colonies, squatter settlements, the informal sector and the incompatible uses are result of neglect, apathy and lack of vision on the part of urban planners.

Planning is a continuous process; responding to multifarious developments - internal as well as external. Delhi has witnessed tremendous growth in last three decades. The Master Plan for Delhi has been extensively modified in accordance with the provision of Delhi Development Act and the modified document has been entitled as 'Master Plan for Delhi Perspective- 2001' (MPD-2001).

The Perspective Plan-2001 ensures an appropriate balance between the spatial allocations for the distribution of housing, employment, social infrastructure, shopping centres, public and individual transport and so on and adequate arrangements and reservations to accomodate different kinds of physical infrastructure and public utility systems. The MPD-2001 thus comprises of co-ordinated policies concerned with virtually all aspects of development in the city accompanied by a series of maps. The salient features of MPD 2001 are as under:

- Delhi to be planned as an integral part of its region.
- Ecological balance to be maintained.
- The central city area to be treated as 'Special Area'.
- Urban heritage of Delhi to be conserved.
- The city centre to be decentralised.
- Mass transport system to be multi-model.
- The urban development to be 'Low Rise High Density'.
- Urban development to be hierarchical.

Slum wing of Delhi administration

The slum and JJ wing of the DDA, MCD and NDMC are responsible for improving the quality of life of slum/jhuggi dwellers in Delhi by undertaking programmes/activities relating to extension of minimum basic facilities required for human living within their areas. Further, a number of schemes and programmes relating to improvement, development, resettlement of squatters living in jhuggi/jhopri clusters have been formulated in the last two decades which are as under:

a) Re-housing scheme: Under the provisions of slum area (Improvement and Clearance Act) the slum wing constructed 21839 flats for slum dwellers, out of which 18935 have been allotted (including allotment of 2119 flats to riots victims/widows). Besides, 77 slum tenaments have also been allotted to slum dwellers and others. Earlier these flats were allotted on licence fee basis but from June, 1984 flats are being allotted on ownership basis under the lease hold system. The cost of flats is recovered in instalments spread over a period of 15 years.

b) Construction and management of night shelters: Night shelters/Vishram Grahas are constructed for weaker section amongst migratory population generally comprising of rickshaw pullers, cart pullers, etc. These are mostly constructed in areas near employment centres for this category. At present the slum wing is operating 60 night shelters which provides spaces for sleeping in winter and rainy seasons to about 3,500 persons. The inmates coming for transitory stays are being provided blankets, jute mattresses, durries and are charged Rs.1.50 per night. These night shelters are also equipped with colour television. At present the work of constructions at Meena Bazar (Jama Masjid), Haz Manjil comprising of Community Welfare Centre and night shelter are also in progress and likely to be completed by the end of this financial year. Besides, plans have been prepared for construction of four night shelters at Laxmi Nagar, Zakhira Flyover, Raja Garden, Janakpuri, Subzi Mandi.

c) Structural improvement and rehabilitation of Katras: The objective of the scheme is to provide need-based repairs in katras/properties which are under the management and control of Slum/JJ Wing and are located in the walled city and its extensions. At present, about 3000 properties are under its management, and thousands of families are residing as tenants. During the year 1991 repairs of these katras were carried out on a need base basis. Under this scheme an expenditure of Rs.108.53 lakhs has been incurred (upto November, 1991). A target of providing repairs in 70 katras will be achieved during this year. About 1250 flats will be constructed at Mata Sundari Road for resetting of 554 families, to be shifted from danger katras. There is a proposal for construction of 261 flats under the Delhi Ajmeri Gate Scheme costing approximately Rs.2.14 crores.

d) Environmental improvement in urban slums: Under this scheme, minimum basic facilities like water supply, sewage, storm water drains, paving lanes, street lights and community facility complexes, etc. are being provided in the notified slum areas. As a result 42, 382 slum dwellers have been benefitted during the year. These facilities are being provided at the rate of Rs.525 per capita. A plan outlay of Rs.200 lakhs was approved for the scheme for the year 1991-92 in order to cover 38095 slum dwellers. An expenditure of Rs.86.80 lakhs had been incurred upto November, 1991 and 16532 slum dwellers have been covered.

e) Construction of Jan Suvidha complexes: A plan for re-modelling/reconstruction of 19 Jan Suvidha Complexes at the first instance at a cost of Rs.1.41 crores has been prepared in the walled city and its extensions. These complexes would be completed during the year 1992-93, and, it is estimated that an expenditure of about Rs.44 lakhs would be incurred during this financial year on this account.

f) Housing registration scheme: A special housing scheme was launched in 1985 for slum dwellers and 27693 applications were received for registration. So far, 1356 flats/tenaments have been allotted to the registrants. Further, two group housing societies comprising of widow registrants were allotted land at Madipur and Jhilmil Colony. Swamy Sidha Group Housing Society with 261 members have constructed flats, and a draw has already been held for 130 flats. The remaining 131 flats will be put to draw as soon as the Cooperative Department of Delhi Administration clears these cases.

g) Development of plots for squatters for self help housing backed by cash construction loan: The scheme relates to relocation of these JJ households where the land owning agencies are in a position to implement the projects on the encroached land/pockets. The budgetary provisions of Rs.17 crores for the current financial year has been approved under the plan head. The layout are designed on a density of 200 units per ha. The beneficiaries are permitted to construct shelter on 18 sq. mtrs. on the ground floor and subsequently when the affordability of allottees improve, the first floor can be added. The resettlement is organised by formation of multipurpose cooperative societies of the squatter families with the help of NGOs/voluntary organisations/charitable trusts. For shelter construction, DCHFS has been designed as the funding agency for provision of loan of Rs.15,000/- per jhuggi household. The loan is recovered from the slum dwellers in 260 instalments alongwith interest. In this regard, an amount of Rs.3,000/- is to be taken from the beneficiaries at the time of allotment of plot. Under this scheme, the Delhi Administration has made a provision of Rs.17 crores for the current financial year and it is expected that 22,000 sites and services plots will be developed within 2 years. These sites are being developed in Rohini, Dwarka and Narela having a total area of about 100 hectares.

h) Development of slum JJ clusters by site relocation of Jhuggi Jhopries: Two schemes known as Prayag Vihar and Ekta Vihar have already been established and during this current year another experimental project in South Delhi in Madrasi Basti for 113 families has been taken up. The beneficiaries are to be given a loan of Rs.7,500/- for construction of shelter through DCHFS in the current financial year. An outlay of Rs.15 lakhs was ear-marked which is likely to be utilised fully.

i) Horticulture works / parks / pot-lots / shishu-vatikas / play grounds: So far, more than 1 lakh sq. mtrs. of area has been converted into green by provision of 67 parks and 16 shishu vatikas in various slum jhuggi-jhopri clusters particularly in the vicinity of Jan Suvidha Complexes and re-housing flats, etc. A woodland in Tilak Vihar area and a nursery at Madipur have also been developed/established.

j) Providing built-up facilities of community halls / social welfare centres / basti vikas kendras / recreational facilities: These facilities are being provided in jhuggi-jhopri clusters for etch of quality life of squatters. So far construction work of 52 basti vikas kendras have already been completed while for 5, the work is in progress.

The slum housing and re-development

Even before the enforcement of the Master Plan, 1962, a beginning has been made for improvement and etch of slum areas in Delhi and also for the relocation and resettlement of squatters/migrants at suitable locations. The Slum (Improvement & Clearance) Act had come into force sometime in the year 1957-58 and the Municipal Corporation of Delhi was made responsible to undertake improvement of slums, rehabilitation and relocation of families affected under the Clearance Scheme and for resettlement of jhuggie clusters. However, absence of institutional linkages and proper follow-up actions have resulted in the hapzard growth of slum areas in Delhi.

New approach towards planning of squatter resettlement

Taking note of recommendations of the Perspective Plan for Delhi, draft National Housing Policy and the suggestions of HUDCO, and also on the basis of the evaluation of the success and failure of the policies for implementation of slum housing schemes, and resettlement of JJ dwellers, a new approach is being evolved specially with regard to their resettlement and improvement of quality of life in JJ clusters. The problem of poorest of the poor namely families residing in JJ clusters needs immediate attention and solution. As such, this programme has assumed priority over other programmes of slum housing schemes.

A three pronged strategy has now been formulated for improvement of quality of life of 1.50 lakhs people residing in JJ clusters. These are; (i) relocation/resettlement, (ii) on-site development and (iii) environmental improvement in JJ clusters.

It is for the first time that efforts are being made in view of the various policies enumerated earlier that relocation/resettlement of JJ dwellers would be taken up as an integral part of the new housing developments. It has been agreed to in principle that each site would provide for 1000 residential plots of 18 sqm. each with common courtyard for group of 5-12 families and such colonies would be developed with a density of 200 plots per ha, at the same time making a provision for facilities required in a housing cluster such as primary school, open spaces, community hall, shopping facilities, etc. about 1 ha of land would be reserved out of a total of 5 ha in each cluster for this purpose.

The JJ clusters which do not require immediate shifting are proposed to be taken up under the scheme of on-site development. Under this scheme, it is proposed to re-arrange the jhuggies in the cluster with the cooperation of the residents so as to achieve a better layout to ensure proper provision of access and laying of services. The individual families would be allotted plots measuring 10-12.5 sqm. and provision would be made for group toilets and bathrooms. Other essential amenities such as balwari, community hall and training centre, etc. are also proposed to be provided alongwith minimum health facilities.

The JJ clusters which are proposed to be shifted in due course of time for the implementation of projects in accordance with the planning of the area and also in locations where on-site development is not feasible on account of very high densities or require shifting on account of undesirable locations, it is proposed to continue with the programme of environmental improvement by providing minimum basic amenities namely (i) brick pavement of access roads, (ii) water hydrants/hand-pumps, (iii) street lighting, (iv) dhalaos and (v) drainage facilities.

However, no mention has been made anywhere in the Master Plan or schemes for urban slums on what is to be done about the energy needs of urban poor in Delhi. The present study is a step towards that direction in order to understand and appreciate the energy needs of slum dwellers of Delhi.

Annexure 3.1

List of selected clusters

Type		South Zone		North Zone
IV	1.	(S-1) Sanjay colony, Okhla Industrial Area, Phase-II, [148/2952]	1.	(N-3) JJ clusters, Along railway line, near Prem Bari Bridge, [159/3171]
	2.	(S-2) JJ clusters. Nehru place, [219/4388)	2.	(N-28) Chandera Shekhar JJ camp, Industrial Area, Wazirpur, [193/3850]
	3.	(S-6) Navjivan camp, Near Govindpuri, [156/3122]	3.	(N-41) JJ camp, Suraj Park Thana, In front of Bawana Road, Samaipur, Badali, [116/2317]
	4.	(S-9) Janta Jivan camp, Tigri, [361/7227]	4.	(N-442) Indira JJ camp, Shahbad, Daulatpur, [313/6272]
	5.	(S-21) Indira Kalyan Vihar, Okhla, Phase-I, [115/2307)		
	6.	(S-38) Bhoomiheen camp, DDA flats, Kalkaji, [112/2244]		

Contd.....

Type	South Zone		North Zone
9.	(S-195) Near Shiv Mandir, Giri Nagar, Kalkaji, [27/106]	9.	(N-140) Mubarakbagh, Behind model town police station, [30/121]
10.	(S-314) Madrasi camp, Moti Bagh-I, [28/113]	10.	(N-100) JJ cluster, Madrasi colony, Morigate, [[31/122]
11.	(S-918) North of Jamia college, Mehboob Nagar Playground, New Okhla, [25/101]	11.	(N-115) JJ camp, Near gas cylinder godown, Opp. S.P.-Block, Pitampura, [32/129]
12.	(S-58) Railway quarters, Okhla tank, Mathura Road, [33/131]		
13.	(S-50) JJ camp, Tajpur Pahari Roadside, Badarpur, [26/105]		
14.	(S-93) Sardar Surat Singh, JJ camp, 2376, Yusuf Sarai, Near Gen Raj School, [27/108]		

Contd.....

Type		East Zone		West Zone
IV	1.	(E-49) Janta Mazdoor Camp, Zafrabad, Seelampur, [287/5740]	1.	(W-3) Near Park Side, C-2, Bus stand, Block C-28, Janakpuri, [103/2060]
	2.	(E-57) Block G-3, 5, Sundernagri, [116/2320]	2.	(W-7) Ketpully colony, Opp. Shadipur depot, [105/2106]
			3.	(W-46) JJ camp, F-Block, Near Central School, Raghubir Nagar, [122/2443]
			4.	(W-144) JJ camp, A&B, Near Nallah Sudarshan Park, Moti Nagar, [105/2100]
III	1.	(E-1) JJ Indira camp, Rainy Kuan No.5-9, Near Chungi Vikas Marg, [135/1345]	1.	(W-108) JJ camp, Gamta Dham, Near Hari Nagar, Ghanta Ghar, [139/1393]
	2.	(E-44) Block-F, New Seemapuri, [134/1337]	2.	(W-153) Rama Road, B-58, Ghaulis Basti, Behind Kulsi factory, [125/1246]
	3.	(E-13) Alongwith Pushta - E,I,J Block, Seelampur, [123/1234]	3.	(W-92) JJ camp, Rakhi market, Near railway crossing, New Rohtak Road, Zakhira, [119/1192]
	4.	(E-83) Sanjay Amar colony, Viswas Nagar, [184/1841]		

Contd.....

Type		East Zone		West Zone
II	1.	(E-11) Buland Masjid Shastri Park & Cluster, Opp. Behari Building, Old Y. Bridge [120/719]	1.	(W-155) Near Chara Mandi, Zakhira, [117/700]
	2.	(E-59) Kalandar colony, Dilshad Garden, Shadra, [117/703]	2.	(W-12) JJ cluster, Road No.5, Jwalpuri, Nangloi, [123/740]
	3.	(E-80) Jhilmil colony, Behind Krishna market, [113/679]	3.	(W-22) JJ camp, WX E- Block, Near railway line, Mayapuri, Phase-II, [91/548]
	4.	(E-36) Ambedkar camp, Block 32 and 34, Trilokpuri, [---/742]		
I	1.	(E-21) Rajgurgh JJ camp, Joshi Mohalla Mandawali, Fazalpur, [28/110]	1.	(W-35) JJ camp, Y-Block, Dhobhinagar, Mangolepuri, [29/116]
	2.	(E-26) Rajeev camp, Block-26, Trilokpuri, [27/108]	2.	(W-76) JJ IG Area, Jyoti camp, Near Gangaram Hos., Old Rajinder Nagar, [30/119]
	3.	(E-77) Nehru camp, Cong-I Highway Road, Patparganj Road, [30/121]	3.	(W-133) JJ cluster, A-2 Paschim Vihar, [27/108]
	4.	(E-4) Pocket-II, Mayur Vihar, [40/160]	4.	(W-167 {i}) Krishnapark, Vikaspuri, Indira camp, [28/113]
			5.	(W-640) D-I, Machli Chowk, Sultanpuri, [26/104]

Type		South Zone		North Zone
III	4.	(S-8) Subhash camp, Block 5,6, & 7, Dakshinpuri, [129/1289]	4.	(N-39) JJ camp, Sarai Pipalthalla, Adarsh Nagar, [121/1214]
	5.	(S-39) Alaknanda camp, DDA flats, Kalkaji, [158/1580]	5.	(N-22) JJ camp, Near Kaushalpur, Near A-Block, Railway line, Azadpur, [127/1274]
II	1.	(S-55) JJ camp, Mollar Bandh, Behind NTPC, Badarpur, [118/705]	1.	(N-21) Mauziwala Bagh, JJ camp, GT Karnal Road, Azadpur, [114/683]
	2.	(S-126) Kanak Durga Colony camp, Sector-12, R.K. Puram, [114/683]	2.	(N-154) Sanjay Gandhi camp, Sector-P, Rohini, [117/700]
	3.	(S-105) Arjun camp, Mahipalpur, Pahari, [113/680]	3.	(N-15) JJ camp, Sethi camp, Indira Vikas colony, Opp: Sant Nirankari Sr. Sec. School, Nirankari colony, [91/548]
	4.	(S-14) Janta Jivan camp, Near Rajiv camp, Okhla, Phase-II, [130/779]		
	5.	JJ camp, Dhibi Ghat Chitra lane, Behind Kirbi Palace, Delhi Cantt. [98/588]		

Contd.....

Type		South Zone		North Zone
I	1.	(S-44) Shiva camp, Behind Vasant Vihar DTC deport, [30/118]	1.	(N-32 {ii}) Nehru Basti Kalai, Basti, Sita Saran colony, [27/109]
	2.	(S-75) Banjara camp, Cirki market, Khanpur, [28/113]	2.	(N-53 {ii}) JJ cluster, B-Block, Near Shamshan Ghat, Wazirpur, [28/110]
	3.	(S-87) Sanjay Vihar camp, Opp. 1-A Rajkilla, G.K.I., [30/119]	3.	(N-74) JJ camp, Behind petrol pump depot, Block, 23, Near Bullward Road, [28/110]
	4.	(S-85) Lal Gumbad, Near Panch Sheel Park, Malviya Nagar, [27/108]	4.	(N-105) Rajiv Gandhi Shekhari Jhopar Patti, Prasad JJ colony, L-Block, Shakurpur, [27/108]
	5.	(S-113) Near water tank, N-Block, Panchsheel park, [29/117]	5.	(N-109) Rahul Gandhi camp, I-Block, Ashok Vihar, Phase-I, [28/110]
	6.	(S-122) Purani Basti, Nangle Diary, [28/112]	6.	(N-110) JJ Area, Rajasthan Udyog Nagar, [28/113]
	7.	(S-136) Near water tank, Swami Nagar. [29/117]	7.	(N-209) Near Arya Samaj Mandir, Shakti Nagar Extension, [29/116]
	8.	(S-185) Indira camp, C-Block, East of Kailash, [29/114]	8.	(N-12) Between railway lines, Near Gopal Mandir, [25/101]

Contd.....

Annexure 4.1
Frequency distribution of fuels

ANNEXURE 3.1

LISTING SCHEDULE

Serial No. : ____________

Name of Investigator : ____________

Date & Time : ____________

1. LOCATION

1.1 **Zone/Cluster/Household**

2. HOUSEHOLD INFORMATION

2.1 Name of respondent — ____________

2.2 Family size -- ____________ ☐

No. of Household Members	Occupation	Income/month
A) Adults		
– Male		
– Female		
B) Children		
– Male		
– Female		

2.3 **Total Family Income per month** — ____________ ☐

3. ENERGY CONSUMPTION PATTERN

3.1 Consumption Information

End-use	Appliance	Fuel	Source	Monthly Consump.	Amount Spent/ month
a) Cooking					
—					
—					
b) Lighting					
—					
—					
c) Water/Space Heating					
d) Electrical Gadgets					
e) Others					
Total					

3.2

Fuel	Consumption month

4. SPECIAL FEATURES (IF ANY)

5. COMMENTS ON THE HOUSEHOLD

ANNEXURE 3.2

TERI DEDA PROJECT

KEROSENE ENDUSE DEMAND SURVEY

Questionnaire No :

Z C HH :

Name of respondent :

Date & Time :

Total kerosene used (In litres) : 1st Estimate ________

2nd Estimate ________

Is electricity used : Yes / No

Cooking

Appliance	Quantity of kerosene per filling (lit.)	No. of fillings per month (No.)	Total kerosene used (lit.)

Lighting

Appliance	Quantity of kerosene per filling (lit.)	No. of fillings per month (No.)	Total kerosene used (lit.)

Results

Y/N TK CK LK :

```
K
     Count   Midpoint
        13       4.00 3\     .
        69       6.00 3\\\\\\\  .
        13       8.00 3\           .
       119      10.00 3\\\\\\\\\\\\   .
       494      12.00 3\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
       191      14.00 3\\\\\\\\\\\\\\\\\\\  .
       304      16.00 3\\\\\\\\\\\\\\\\\\\\\\\:\\\\\\
       310      18.00 3\\\\\\\\\\\\\\\\\\\\\\\:\\\\\\\
       283      20.00 3\\\\\\\\\\\\\\\\\\\\\\\:\\\\
       224      22.00 3\\\\\\\\\\\\\\\\\\\\\:
       208      24.00 3\\\\\\\\\\\\\\\\\\\:\
       127      26.00 3\\\\\\\\\\\\\   .
        92      28.00 3\\\\\\\\\    .
        92      30.00 3\\\\\\\\\ .
        33      32.00 3\\\    .
        25      34.00 3\\\ .
        24      36.00 3\\ .
        14      38.00 3\.
        11      40.00 3:
         9      42.00 3:
         3      44.00 3
         3      46.00 3
         3      48.00 3
         0      50.00 3
                      I....+....I....+....I....+....I....+....I....+....I
                      0        100       200       300       400       500
                                 Histogram Frequency
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FREQUENCIES /VARIABLES E /HISTOGRAM MIN (2) MAX (80) INCREMENT (5) NORMAL.

E
    Count    Midpoint
       25        4.50 3\\                 .
      736        9.50 3\\\\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\
       51       14.50 3\\\
      142       19.50 3\\\\\\\\\
      236       24.50 3\\\\\\\\\\\\\\:
       50       29.50 3\\\       .
      223       34.50 3\\\\\\\:\\\\\\
       79       39.50 3\\\\:
       19       44.50 3\.
       18       49.50 3:
        7       54.50 3.
        9       59.50 3\
        2       64.50 3
        2       69.50 3
        2       74.50 3
        0       79.50 3
                      I....+....I....+....I....+....I....+....I....+....I
                      0       160       320       480       640       800
                                Histogram Frequency

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FREQUENCIES /VARIABLES D /HISTOGRAM MIN (5) MAX (150) INCREMENT (5) NORMAL.

D
  Count   Midpoint
     46       7.50 3\\\\\\\\\\\\\\\\\\\\\\\
     85      12.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
     15      17.50 3\\\\\\\\
     59      22.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
     20      27.50 3\\\\\\\\\\
     40      32.50 3\\\\\\\\\\\\\\\\\\\\
      2      37.50 3\
     96      42.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\:
      1      47.50 3\                                           .
     21      52.50 3\\\\\\\\\\\                             .
      0      57.50 3                                     .
     21      62.50 3\\\\\\\\\\\                      .
      1      67.50 3\                            .
      4      72.50 3\\                        .
      1      77.50 3\                      .
     55      82.50 3\\\\\\\\\\\\\\\\\\\:\\\\\\\\
      0      87.50 3                .
      5      92.50 3\\\           .
      0      97.50 3           .
     14     102.50 3\\\\\\\  .
      0     107.50 3       .
      0     112.50 3      .
      0     117.50 3    .
     21     122.50 3\\\:\\\\\\\
      1     127.50 3\ .
      0     132.50 3  .
      0     137.50 3 .
      1     142.50 3\.
      6     147.50 3:\\
                   I....+....I....+....I....+....I....+....I....+....I
                   0        20        40        60        80        100
                             Histogram Frequency

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FREQUENCIES /VARIABLES F /HISTOGRAM MIN (2) MAX (200) INCREMENT (8) NORMAL.


 Count    Midpoint
    47        6.00 3\\\\\\              .
   177       14.00 3\\\\\\\\\\\\\\\\\\\\\:
   211       22.00 3\\\\\\\\\\\\\\\\\\\\\\:\\\
    80       30.00 3\\\\\\\\\\            .
   233       38.00 3\\\\\\\\\\\\\\\\\\\\\\:\\\\\\
     8       46.00 3\                    .
   108       54.00 3\\\\\\\\\\\\\\     .
   107       62.00 3\\\\\\\\\\\\\    .
    21       70.00 3\\\            .
   115       78.00 3\\\\\\\\\\\\\:
     1       86.00 3          .
    30       94.00 3\\\\    .
    67      102.00 3\\\\\\:\
     1      110.00 3    .
    71      118.00 3\\\:\\\\\
     0      126.00 3  .
     1      134.00 3 .
     3      142.00 3.
    46      150.00 3:\\\\\
    14      158.00 3:\
     0      166.00 3
     0      174.00 3
     6      182.00 3\
     0      190.00 3
    16      198.00 3\\
                   I....+....I....+....I....+....I....+....I....+....I
                   0         80        160       240       320       400
                            Histogram Frequency

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FREQUENCIES /VARIABLES C /HISTOGRAM MIN (5) MAX (100) INCREMENT (5) NORMAL.

 C
    Count   Midpoint
        8       7.50 3\\\\\\\\\\\
        5      12.50 3\\\\\\\
        2      17.50 3\\
       27      22.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        7      27.50 3\\\\\\\\\\
        9      32.50 3\\\\\\\:\\\\
        1      37.50 3:
       35      42.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        3      47.50 3\\\\
        7      52.50 3\\\\\\\\\\
        0      57.50 3
       10      62.50 3\\\\\\\\\\\\\
        0      67.50 3
        4      72.50 3\\\\\
        0      77.50 3
        8      82.50 3\\\\\\\\\\\
        0      87.50 3
        2      92.50 3\\
        3      97.50 3\\\\

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north zone

FREQUENCIES /VARIABLES K /HISTOGRAM MIN (2) MAX (70) INCREMENT (4) NORMAL.

K
    Count   Midpoint
       15        4.00 3\         .
       12        8.00 3\           .
      537       12.00 3\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
      462       16.00 3\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\
      519       20.00 3\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\
      329       24.00 3\\\\\\\\\\\\\\\:\\\\\\\\\\\
       94       28.00 3\\\\\\\\      .
       76       32.00 3\\\\\\      .
       23       36.00 3\\        .
       12       40.00 3\      .
        7       44.00 3\    .
        1       48.00 3   .
        4       52.00 3  .
        1       56.00 3 .
        1       60.00 3.
        4       64.00 3.
        2       68.00 3
                      I....+....I....+....I....+....I....+....I....+....I
                      0       120       240       360       480       600
                                Histogram Frequency
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FREQUENCIES /VARIABLES F /HISTOGRAM MIN (5) MAX (100) INCREMENT (5) NORMAL.

F
    Count   Midpoint
       24       7.50 3\\\\\\                         .
      108      12.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\       .
       88      17.50 3\\\\\\\\\\\\\\\\\\\\\            .
      183      22.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\
       55      27.50 3\\\\\\\\\\\\\\                 .
      106      32.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\   .
       13      37.50 3\\\                        .
      131      42.50 3\\\\\\\\\\\\\\\\\\\\\\\:\\\\\\\\
        3      47.50 3\                   .
       55      52.50 3\\\\\\\\\\\\\\   .
        0      57.50 3              .
       47      62.50 3\\\\\\\\\\\:
        1      67.50 3         .
        9      72.50 3\\    .
        7      77.50 3\\  .
       40      82.50 3\\\:\\\\\\
        0      87.50 3  .
        3      92.50 3\.
       48      97.50 3:\\\\\\\\\\\

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FREQUENCIES /VARIABLES D /HISTOGRAM MIN (2) MAX (100) INCREMENT (5) NORMAL.

D
    Count   Midpoint
       15       4.50 3\\\\                             .
      105       9.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\        .
       40      14.50 3\\\\\\\\\\                        .
      116      19.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\     .
       12      24.50 3\\\                             .
       43      29.50 3\\\\\\\\\\\                  .
        4      34.50 3\                         .
       45      39.50 3\\\\\\\\\\\            .
        0      44.50 3                   .
       41      49.50 3\\\\\\\\\\      .
        0      54.50 3             .
       43      59.50 3\\\\\\\\\\:
        1      64.50 3       .
        6      69.50 3\\   .
        1      74.50 3   .
       52      79.50 3\\:\\\\\\\\\\
        0      84.50 3 .
        2      89.50 3:
        0      94.50 3.
       46      99.50 3:\\\\\\\\\\\

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FREQUENCIES /VARIABLES E /HISTOGRAM MIN (7) MAX (90) INCREMENT (5) NORMAL.

E
    Count   Midpoint
      536       9.50 3\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\
       59      14.50 3\\\\\             .
       39      19.50 3\\\               .
      430      24.50 3\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\
       99      29.50 3\\\\\\\\        .
      224      34.50 3\\\\\\\\\\\\\:\\\\\
      154      39.50 3\\\\\\\\\\:\\
       34      44.50 3\\\    .
       38      49.50 3\\\ .
        3      54.50 3  .
       14      59.50 3\.
        5      64.50 3.
        4      69.50 3
       10      74.50 3\
       18      79.50 3\\
        6      84.50 3\
        2      89.50 3
                     I....+....I....+....I....+....I....+....I....+....I
                     0       120       240      360       480       600
                               Histogram Frequency

---------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES C /HISTOGRAM MIN (1) MAX (100) INCREMENT (5) NORMAL.

C
    Count   Midpoint
        4       3.50 3\\\\\\\\\\\\\\\\\\\\
        6       8.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        6      13.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        9      18.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        4      23.50 3\\\\\\\\\\\\\\\\\\\\
        1      28.50 3\\\\\
        0      33.50 3
        6      38.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        0      43.50 3
        0      48.50 3
        0      53.50 3
        7      58.50 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        0      63.50 3
        1      68.50 3\\\\\
        0      73.50 3
        4      78.50 3\\\\\\\\\\\\\\\\\\\\
        0      83.50 3
        1      88.50 3\\\\\
        0      93.50 3
        4      98.50 3\\\\\\\\\\\\\\\\\\\\

----------------------------------------------------------------------
```

```
east zone

FREQUENCIES /VARIABLES K /HISTOGRAM MIN (2) MAX (50) INCREMENT (4) NORMAL

K
    Count   Midpoint
       13       4.00 3\   .
        6       8.00 3\           .
      518      12.00 3\\\\\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\
      360      16.00 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\:
      312      20.00 3\\\\\\\\\\\\\\\\\\\\\\\\\\  .
      241      24.00 3\\\\\\\\\\\\\\\\\\\:
       88      28.00 3\\\\\\\  .
       54      32.00 3\\\:\
       25      36.00 3:\
        6      40.00 3\
        1      44.00 3
        5      48.00 3
                     I....+....I....+....I....+....I....+....I....+....I
                     0       120       240       360       480       600
                               Histogram Frequency

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
FREQUENCIES /VARIABLES F /HISTOGRAM MIN (5) MAX (100) INCREMENT (8) NORMAL.

F
    Count    Midpoint
       49        9.00 3\\\\\\                  .
      198       17.00 3\\\\\\\\\\\\\\\\\\\\\\\\\.
       31       25.00 3\\\\                    .
       57       33.00 3\\\\\\\              .
      228       41.00 3\\\\\\\\\\\\\\\\:\\\\\\\\\\\\
       34       49.00 3\\\\       .
       49       57.00 3\\\\\\ .
        0       65.00 3   .
        3       73.00 3 .
       54       81.00 3:\\\\\\
        7       89.00 3\
       13       97.00 3\\
                      I....+....I....+....I....+....I....+....I....+....I
                      0        80       160       240       320       400
                                 Histogram Frequency

--------------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES D /HISTOGRAM MIN (5) MAX (130) INCREMENT (8) NORMAL.

D
     Count   Midpoint
        17       9.00 3\\             .
        84      17.00 3\\\\\\\\\\\     .
        11      25.00 3\                .
        24      33.00 3\\\              .
       340      41.00 3\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\
        29      49.00 3\\\\          .
        76      57.00 3\\\\\\\\\\  .
         0      65.00 3          .
         2      73.00 3        .
       176     ·81.00 3\\\\\\:\\\\\\\\\\\\\\\
         0      89.00 3    .
        30      97.00 3\\:\
         0     105.00 3 .
         0     113.00 3.
        35     121.00 3:\\\
         0     129.00 3
                      I....+....I....+....I....+....I....+....I....+....I
                      0         80        160       240       320       400
                                Histogram Frequency

----------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES E /HISTOGRAM MIN (2) MAX (90) INCREMENT (5) NORMAL.


E
    Count   Midpoint
        3       4.50 3
      467       9.50 3\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
       45      14.50 3\\\\\            .
       71      19.50 3\\\\\\\            .
      381      24.50 3\\\\\\\\\\\\\\\\\\\:\\\\\\\\\\\\\\\\\\
       78      29.50 3\\\\\\\\          .
      255      34.50 3\\\\\\\\\\\\\\\:\\\\\\\\\\
      104      39.50 3\\\\\\\\\\ .
       79      44.50 3\\\\\\\\.
       20      49.50 3\\  .
       15      54.50 3\\.
       13      59.50 3\.
        4      64.50 3.
        5      69.50 3\
        5      74.50 3\
        0      79.50 3
        5      84.50 3\
        0      89.50 3
                     I....+....I....+....I....+....I....+....I....+....I
                     0       100       200       300       400       500
                               Histogram Frequency
-------------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES C /HISTOGRAM MIN (3) MAX (80) INCREMENT (4) NORMAL.

C
    Count   Midpoint
        2       5.00 3\\\\\
        0       9.00 3
        0      13.00 3
        1      17.00 3\\
        8      21.00 3\\\\\\\:\\\\\\\\\\\\
        0      25.00 3.
        7      29.00 3\\\\\\\\\\\\\\\\\
        0      33.00 3
        1      37.00 3\\
       16      41.00 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        0      45.00 3
        3      49.00 3\\\\\\\
        0      53.00 3
        0      57.00 3
        0      61.00 3
        0      65.00 3
        0      69.00 3
        0      73.00 3
        1      77.00 3\\
        3      80.00 3\\\\\\\
-------------------------------------------------------------------------------------
```

```
west zone

FREQUENCIES /VARIABLES K /HISTOGRAM MIN (2) MAX (50) INCREMENT (2) NORMAL.

K
    Count   Midpoint
       11       3.00 3\   .
        9       5.00 3\    .
       10       7.00 3\     .
        2       9.00 3       .
       11      11.00 3\      .
      296      13.00 3\\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\
      157      15.00 3\\\\\\\\:\\\\\\\\\\\
      168      17.00 3\\\\\\\\\:\\\\\\\\\\\
      191      19.00 3\\\\\\\\\:\\\\\\\\\\\\\\
       98      21.00 3\\\\\\\\\:\\
      150      23.00 3\\\\\\\\\:\\\\\\\\\
      112      25.00 3\\\\\\\\\:\\\\
      102      27.00 3\\\\\\\\:\\\\
       19      29.00 3\\     .
       23      31.00 3\\\    .
       27      33.00 3\\\   .
       17      35.00 3\\   .
       12      37.00 3\\  .
        1      39.00 3   .
        4      41.00 3\  .
        8      43.00 3\ .
        6      45.00 3\.
        1      47.00 3 .
        1      49.00 3.
                     I....+....I....+....I....+....I....+....I....+....I
                     0        80       160       240       320       400
                              Histogram Frequency

-----------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES F /HISTOGRAM MIN (3) MAX (200) INCREMENT (10) NORMAL.

F
    Count    Midpoint
       66        8.00 3\\\\\\\\\\\\\\\\\.
       96       18.00 3\\\\\\\\\\\\\\\\\\:\\\\\
       80       28.00 3\\\\\\\\\\\\\\\\\\\:
      104       38.00 3\\\\\\\\\\\\\\\\\\\:\\\\\\
       58       48.00 3\\\\\\\\\\\\\\\    .
       50       58.00 3\\\\\\\\\\\\\     .
       10       68.00 3\\\              .
       43       78.00 3\\\\\\\\\\\     .
        8       88.00 3\\             .
       36       98.00 3\\\\\\\\\    .
        1      108.00 3            .
       32      118.00 3\\\\\\\\  .
        3      128.00 3\        .
        0      138.00 3       .
       66      148.00 3\\\\\\:\\\\\\\\\\
        2      158.00 3\   .
        0      168.00 3   .
        8      178.00 3\\.
        1      188.00 3  .
       21      198.00 3\:\\\
--------------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES D /HISTOGRAM MIN (3) MAX (200) INCREMENT (10) NORMAL.


D
    Count   Midpoint
        3       8.00 3\\\
       20      18.00 3\\\\\\\\\\\\\\\\\
        9      28.00 3\\\\\\\\
       51      38.00 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        7      48.00 3\\\\\\
       12      58.00 3\\\\\\\\\\
        1      68.00 3\                       .
       30      78.00 3\\\\\\\\\\\\:\\\\\\\\\\\\
        5      88.00 3\\\\ .
       10      98.00 3\:\\\\\\
        0     108.00 3.
        8     118.00 3\\\\\\\
        0     128.00 3
        0     138.00 3
       15     148.00 3\\\\\\\\\\\\\
        4     158.00 3\\\
        0     168.00 3
        2     178.00 3\\
        1     188.00 3\
        6     198.00 3\\\\\
--------------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES E /HISTOGRAM MIN (2) MAX (100) INCREMENT (5) NORMAL.

E
    Count   Midpoint
        2       4.50 3      .
      372       9.50 3\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
       49      14.50 3\\\\\\ .
       96      19.50 3\\\\\\\:\\\\
      204      24.50 3\\\\\\\:\\\\\\\\\\\\\\\\\\
       51      29.50 3\\\\\\ .
      257      34.50 3\\\\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\
      177      39.50 3\\\\\\:\\\\\\\\\\\\\\\
       60      44.50 3\\\\\\:\
       18      49.50 3\\    .
        5      54.50 3\    .
       13      59.50 3\\   .
        7      64.50 3\    .
        4      69.50 3\   .
        5      74.50 3\   .
        3      79.50 3   .
        3      84.50 3   .
        4      89.50 3\ .
        6      94.50 3\ .
        1      99.50 3 .
--------------------------------------------------------------------------------
```

```
FREQUENCIES /VARIABLES C /HISTOGRAM MIN (10) MAX (125) INCREMENT (8) NORMAL.

C
    Count   Midpoint
        6      14.00 3\\\\\\\
       19      22.00 3\\\\\\\\\\\\\\\\\\\\\\\\
        6      30.00 3\\\\\\\
       34      38.00 3\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
        0      46.00 3                  .
       18      54.00 3\\\\\:\\\\\\\\\\\\\\\\
        4      62.00 3:\\\\
        3      70.00 3\\\\
        8      78.00 3\\\\\\\\\\
        0      86.00 3
        0      94.00 3
        8     102.00 3\\\\\\\\\\
        0     110.00 3
        1     118.00 3\
        0     125.00 3
                     I....+....I....+....I....+....I....+....I....+....I
                     0         8        16        24        32        40
                               Histogram Frequency
```

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